



# ***TVSTUDY***

## **INSTRUCTION MANUAL**

Office of Engineering and Technology  
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## **USING TVSTUDY**

### **Launching TVStudy**

To launch TVStudy, navigate your terminal to the directory where TVStudy was installed and then type and run:

```
java -jar tvstudy.jar
```

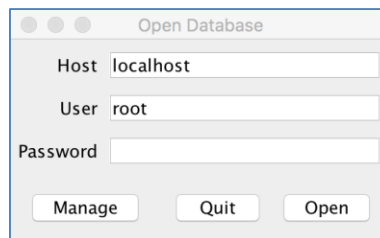
If you are running on the Mac platform, you could instead launch tvstudy.jar from Finder.

If you are running on the Linux platform and receive an error message that looks like this:

```
Exception in thread "main" java.lang.UnsupportedClassVersionError:  
gov/fcc/tvstudy/AppManager : Unsupported major.minor version 51.0
```

You may have two versions of Java installed and TVStudy is attempting to launch using the older one. To resolve this issue, remove the older version of Java from your system using the normal method of removing such software. TVStudy 2.x requires the Java 8 JDK.

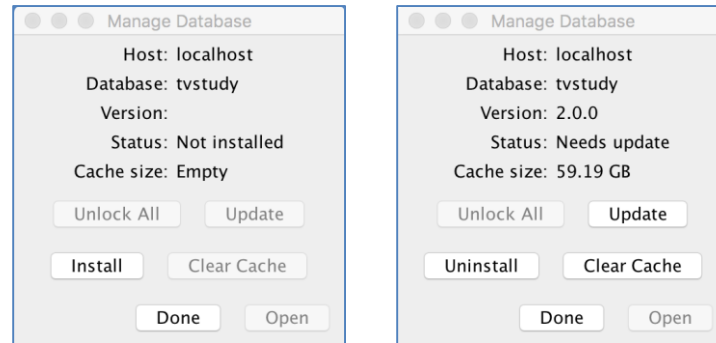
Upon opening TVStudy, you will see the Open Database window.



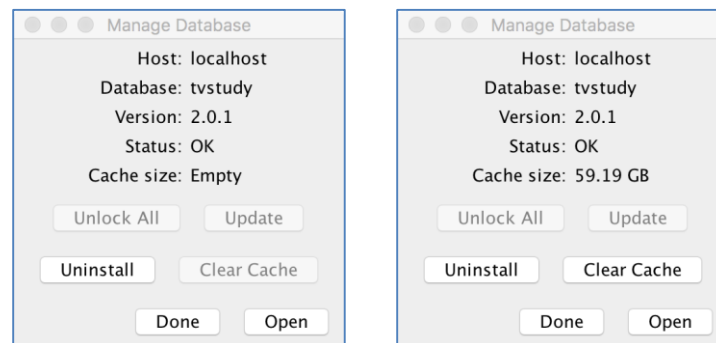
If you're running your MySQL database server on your machine, you may need to enter "localhost" or "127.0.0.1" as your host name. You will need the user name and password to access your database. When finished, click "Open."

## Managing the TVStudy Database

If this is your first time running a new or updated version of TVStudy, the software will open the “Manage Database” window. If not, you can open the Manage Database window by clicking “Manage” after putting your password into the “Open Database” window.

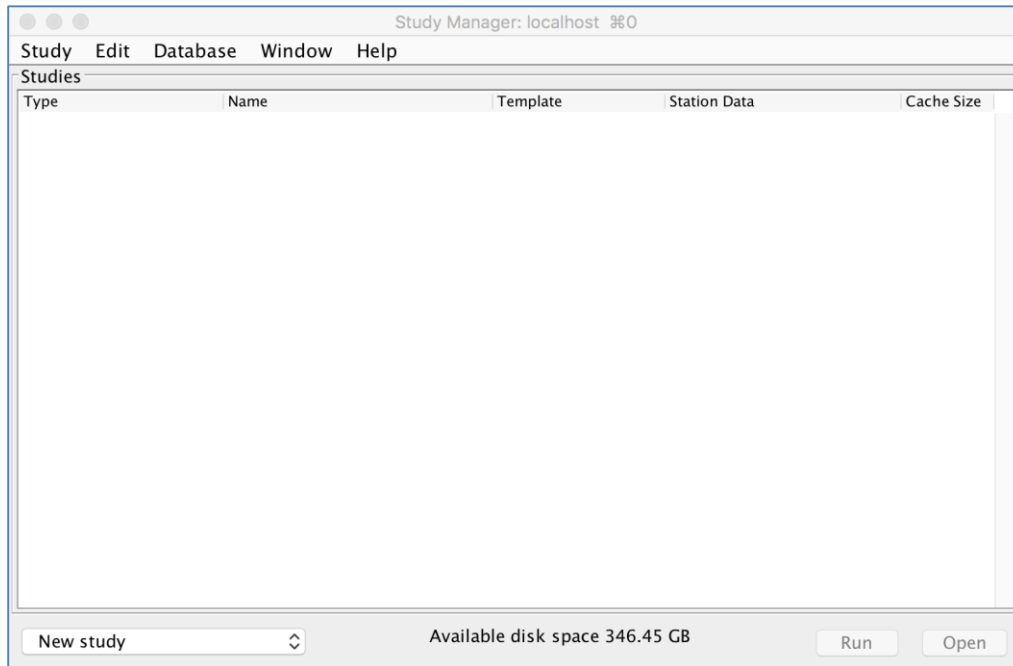


This window allows you to update your database to the latest version if you are upgrading, or install the root database for a new installation. Click “Install” or “Update,” as appropriate, and it will do so automatically, taking up to about 20 minutes, depending on the speed of your computer.



This window also allows you to resolve some common database issues, such as locked databases preventing you from gaining access to the Study Manager window, corrupt database, or cache problems by clicking the appropriate buttons.

## Study Manager Window



The first time opening the software you will see an empty Study Manager window, as shown above. This window will allow you to see your studies and configure TVStudy for use. In TVStudy, datasets and templates are managed from the Database drop-down menu, rather than through the Create New Study window as was the case in older versions of TVStudy.

Sometimes, lines in this window will have colors associated with them. A full list of the possible colors in the Study Manager window is provided below.

**Blue** indicates a study that has a description, which can be viewed by hovering over the blue text.

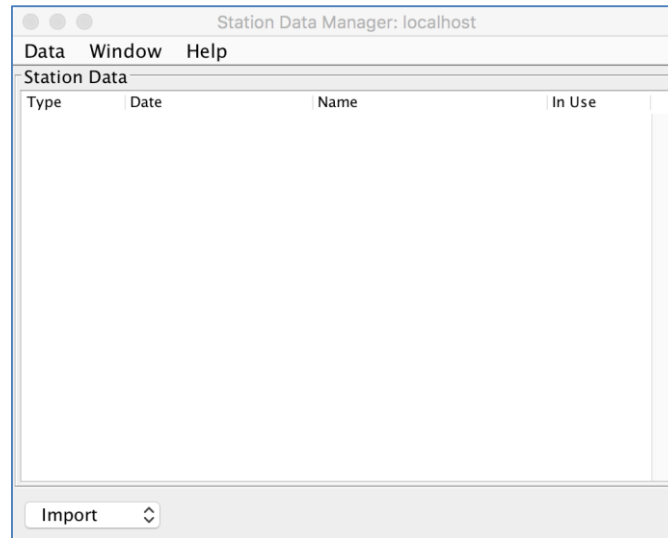
**Green** indicates a study that is open for editing.

**Red** indicates a study that is presently being run.

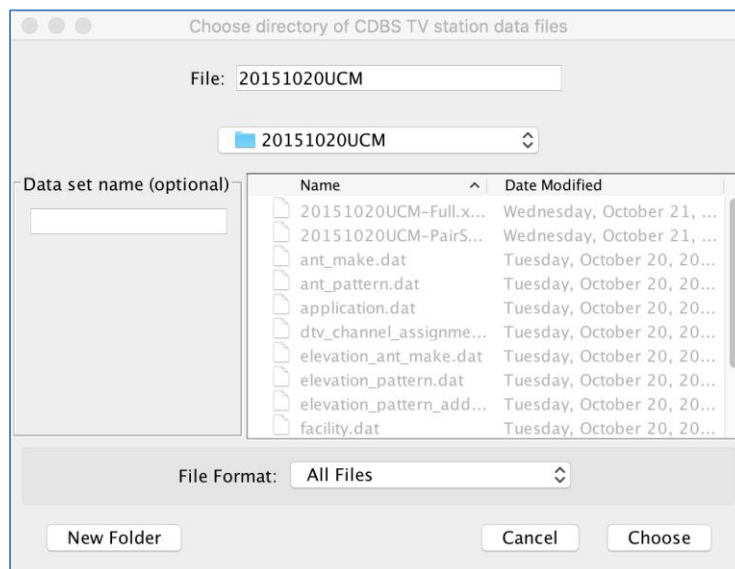
Gray indicates a study that is locked for some other reason.

## Managing Datasets

TVStudy has the capability of performing various types of analyses pertaining to broadcasting. In order to use TVStudy to run analyses, you should import at least one CDBS or LMS dataset. If you are looking to conduct an OET Bulletin No. 74 analysis, a dataset of wireless sites and antenna patterns is also required (see Appendix B). To import a dataset, begin by opening the Database menu and choosing Station Data Manager.



At the bottom corner, click the “Import” drop-down and choose the type of dataset you would like to import. (Note that to use a CDBS dataset for both TV and FM, it must be imported twice, once for each option in this menu.) Navigate to the location containing your CDBS<sup>1</sup>, LMS<sup>2</sup>, or wireless data files for import.



<sup>1</sup> To download today's CDBS dataset, see: <https://www.fcc.gov/encyclopedia/cdbbs-database-public-files>

<sup>2</sup> To download today's LMS dataset, see: <https://enterpriseefiling.fcc.gov/dataentry/public/tv/lmsDatabase.html>



In the image above, a copy of the November 2015 CDBS Extract dataset associated with the incentive auction has been selected, as an example. In the pane at the side of the window, you can give the dataset a name, which is optional. If you are doing a number of studies with different datasets, naming each dataset may prove useful in helping to keep them organized. Either click “Choose” to use the default name, or after entering a name, click “Choose.” Clicking “Cancel” will prevent the dataset from being imported. If you are importing a wireless dataset, a second window will appear asking you to choose the associated wireless antenna pattern dataset.

For an import of CDBS or LMS data to be successful, TVStudy needs, at a minimum, the files listed in Appendix B. A complete dataset file set should always succeed in importing as long as the set is not corrupt.

After a brief wait while the dataset files are imported, you should now see your dataset in the list.

Please note that if you receive an error message at this point when importing an older CDBS dataset, it may be the result of an incompatibility between TVStudy and the CDBS data. On December 2, 2014, the application.dat file was modified, and TVStudy 1.3.2 was the first version which properly handled the new format. However, TVStudy no longer handles the previous format by default. In the /lib directory, a command line utility called fix\_application is provided to adjust the format of an older application.dat to be compatible with the current version. Additionally, but not recommended, you could modify the layout TVStudy is expecting of CDBS datasets by modifying the lib/cdbbs\_table\_defs.dat file and restarting TVStudy.

To rename or delete a dataset, simply click the Data menu and choose Rename or Delete, respectively. You can delete a dataset only if it is not being used for any studies.

## View and Manage Dataset Records

TVStudy has the ability to view the data contained in a dataset without first creating a study. You can also use this mode to create user records for later use, or import or export individual station records.

To access this feature, go to the Database menu and choose “View Station Data.”

### User Records

User records, contained in the User records database, are records imported or entered by the TVStudy user. User records exist to allow users to check the results of alternate station parameters on interference studies. **Once created, user records cannot be deleted.**

### Viewing Records

To view a record, choose which dataset you would like to use from the “Station Data” section, choose your search parameters, if any, and then click “Search”. Matching results will appear in the window at the bottom. When you select one and click “View” you will see the data associated with the record. Any set of results can be filtered using the filter options below the Records pane.

Note the button to “Add SQL”. This allows you to enter custom search parameters based on any field in CDBS or LMS. For example, when using a CDBS dataset, you could enter the following query and your search would only return results that are within Zone I, excluding any that fail to meet other criteria selected in the other part of the window:

```
tv_eng_data.fac_zone = 1
```

For a full set of query examples, please see Appendix I on page 90.

***Importing and Exporting Records***

From this window it is possible to import XML records into the User records database or export XML records from any dataset.

To import a record, simply click the “Import” button and locate the XML file containing the record you wish to import. Select the record, click “Import”, and your record will be imported. Once you are satisfied, click “Save” and the record will be added to the User records database. Regardless of the type of station(s) you are importing, from XML TVStudy will ask you to select an existing CDBS/LMS dataset to resolve references in the imported XML file.

To export a record, select the record you wish to export by searching in this window, then click “Export”. Navigate to the directory in which you would like to save your exported record, enter a name for your export file, and then click “Export”.

## Creating Records

You can also manually create records to add to the TV, FM, or wireless User records database from this window, either by entering the parameters by hand or by duplicating an existing record and modifying it prior to saving.

Creating a new record and duplicating an existing record are nearly identical processes. The difference, as you might expect, is that when duplicating an existing record, the new record's values are pre-populated with the data from the record being duplicated. This is useful for creating new records at existing locations, whether these are intended to represent new stations to be located on an existing tower or modifications to existing stations.

If you wish to duplicate, use the search function to search for the record you wish to duplicate. When you've found it, click it, then click "Duplicate". Otherwise, click the "New" drop-down and choose the type of record you wish to create. For this example, we will look at a TV record.

The screenshot shows a window titled "Station Data: localhost" with the following fields and controls:

- Service:** A dropdown menu with "???" selected.
- Facility ID:** A text field with "0" entered.
- Country:** A dropdown menu with "???" selected.
- Call Sign:** A text field.
- Channel:** A dropdown menu with "0" selected, and a frequency field showing "43.25 MHz".
- Status:** A dropdown menu.
- City:** A text field.
- State:** A text field.
- File Number:** A text field.
- Zone:** A dropdown menu with "(n/a)" selected.
- Freq. Offset:** A dropdown menu with "(none)" selected.
- Emission Mask:** A dropdown menu with "(n/a)" selected.
- Site Number:** A text field with "0" entered.
- Latitude (NAD27):** A field with "N" selected, "0" entered, and "0.00" entered.
- Longitude (NAD27):** A field with "W" selected, "0" entered, and "0.00" entered.
- Height AMSL, ...:** A text field with "0.0" entered.
- HAAT, m:** A text field with "0.0" entered.
- Peak ERP, kW:** A text field with "0.001" entered.
- Azimuth Pattern:** A dropdown menu with "(none)" selected. Below it is an "Edit" button and "Orient. 0.0".
- Elevation Pattern:** A dropdown menu with "(none)" selected. Below it is an "Edit" button.
- Elec. Tilt:** A text field with "0.00" entered.
- Mech. Tilt:** A text field with "0.00" entered.
- Tilt Orient.:** A text field with "0.0" entered.
- May use generic pattern when needed:** A checked checkbox.
- Buttons:** "Cancel" and "Save" buttons at the bottom right.

Then enter the parameters. When you are satisfied, click "Save." When you're back in the "Browse Station Data" window, click "Save" again to save the record to the User records database.

## Antenna Pattern Editor

Antenna Pattern: localhost

Pattern Name

Pattern Orientation  
0.0 ☐ Rotate pattern plot

Data Plot Search

Azimuth Relative Field

Add Insert Delete

Clear Import Export Cancel Save

When editing or creating a record, by clicking “Edit” for the azimuth pattern or elevation pattern, you can either retrieve an existing pattern from a CDBS/LMS dataset, a wireless dataset, or manually specify your own pattern. You can also use this window to view, create, or modify patterns in CDBS/LMS/wireless records.

Antenna Pattern: localhost

Pattern Name

Pattern Orientation  
0.0 ☐ Rotate pattern plot

Data Plot Search

Station Data  
CDBS TV 2015/10/20 UCM

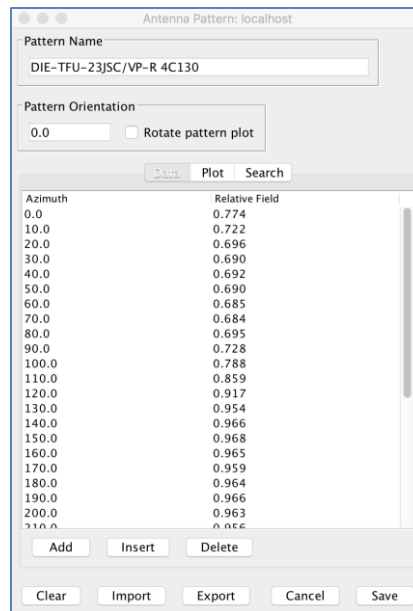
DIE Search

D25-CASAN\_DIEGO\_10  
DIE- TUF-04-16/64H-1  
DIE-18DSC-R P230  
DIE-26JSC-R CT150SP  
DIE-30G27007  
DIE-881-24  
DIE-881-24  
DIE-881-24  
DIE-881-24  
DIE-881-24  
DIE-881-24  
DIE-881-32  
DIE-881-32  
DIE-881-8  
DIE-888

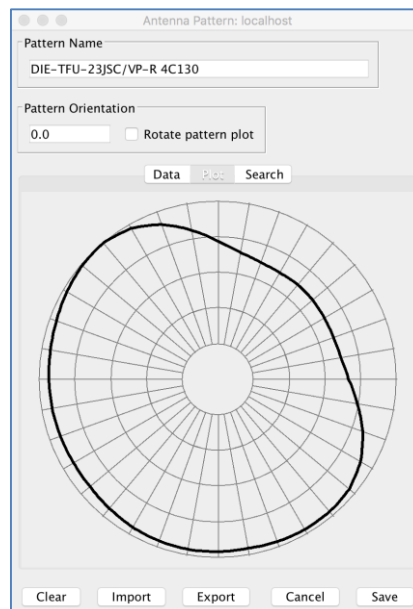
Load

Clear Import Export Cancel Save

Click on the “Search” tab to search for an existing antenna pattern to use. For TV or FM antennas, you can search by make, model, or antenna ID number. For wireless antennas, you can search by antenna ID or antenna name. Note that manufacturer names and model numbering conventions may not be strictly followed in CDBS/LMS records. When you locate the desired pattern, click “Load.”



Here you can see that the field values now appear in the Pattern Data area. You can click and edit the values if you wish. To see the antenna pattern graphically as a polar plot, click on the “Plot” tab.

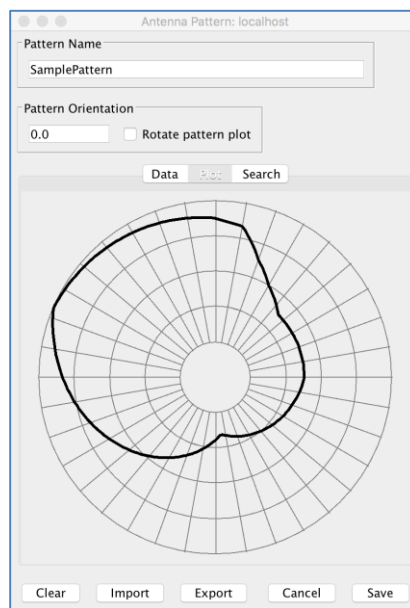


You can Import and Export antenna patterns using the “Import” and “Export” buttons. A CSV file is produced on Export and is required on Import. TVStudy will interpolate between the azimuth angles provided, so you can provide as many or as few azimuth values as you wish. It is advised that your pattern include all maxima and minima.

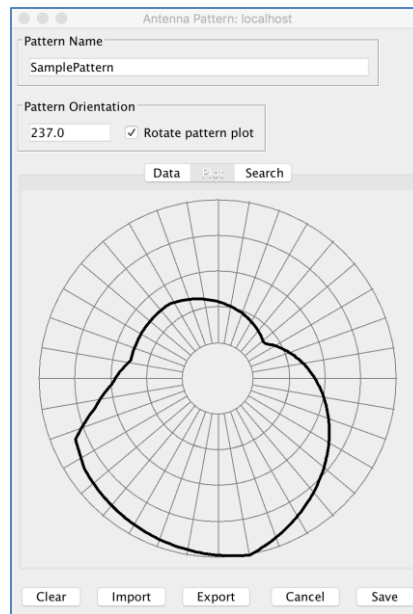
If you want to go revert to an omni-directional pattern, click on “Clear” and all field values will be deleted, thus producing an omni.

Azimuth	Relative Field
0.0	0.900
10.0	0.867
20.0	0.705
30.0	0.598
45.0	0.500
90.0	0.500
175.0	0.322
293.1	1.000

Arbitrary antenna patterns can also be created by using the “Add” button to add azimuths and field values. TVStudy will interpolate between the angles provided, so you can provide data for as many or as few azimuth values as you wish. It is advised that your pattern include all maxima and minima.



The antenna pattern can be displayed graphically by clicking the “Plot” tab, just as with antenna patterns contained in CDBS/LMS/wireless datasets.



Additionally, by checking the “Rotate pattern plot” checkbox and setting a value, you can rotate your antenna pattern. The rotated pattern value represents the pattern rotation with respect to true north, N degrees ET.

When finished, click “Save.” The antenna name will now appear in the Azimuth Pattern section of the Station Data window.

The image shows a dialog box titled "Station Data: localhost". It contains the following fields and controls:

- Service:** A dropdown menu showing "???".
- Facility ID:** A text field containing "0".
- Country:** A dropdown menu showing "???".
- Call Sign:** A text field.
- Channel:** A text field containing "0" and "43.25 MHz".
- Status:** A dropdown menu.
- City:** A text field.
- State:** A text field.
- File Number:** A text field.
- Zone:** A dropdown menu showing "(n/a)".
- Freq. Offset:** A dropdown menu showing "(none)".
- Emission Mask:** A dropdown menu showing "(n/a)".
- Site Number:** A text field containing "0".
- Latitude (NAD27):** A text field showing "N", "0", "0", "0.00".
- Longitude (NAD27):** A text field showing "W", "0", "0", "0.00".
- Height AMSL, ...:** A text field containing "0.0".
- HAAT, m:** A text field containing "0.0".
- Peak ERP, kW:** A text field containing "0.001".
- Azimuth Pattern:** A section containing a text field "SamplePattern" and a text field "Orient. 237.0", with an "Edit" button below them.
- Elevation Pattern:** A section containing a text field "(none)" and an "Edit" button below it.
- Tilt Settings:** Three text fields: "Elec. Tilt" (0.00), "Mech. Tilt" (0.00), and "Tilt Orient." (0.0).
- Checkboxes:** A checked checkbox labeled "May use generic pattern when needed".
- Bottom Buttons:** "Cancel" and "Save" are located at the bottom right of the dialog.

Please note that if you edit an elevation pattern and do not provide a field value at 90 degrees below the horizon (straight down), TVStudy will hold the last value. So if the last value provided is a 0.2 field value at 20 degrees, TVStudy will assume that the 0.2 field value is a uniform value used all the way to 90 degrees. To have it diminish to 0.001 by linear interpolation, the minimum value allowed by TVStudy, set a 0.001 field value at 90 degrees.



## Viewing DTS Facilities

Distributed Transmission System (DTS) facilities have multiple transmitter sites for a single facility ID and record. The method for viewing these is slightly different from the method for conventional stations. To begin, select a DTS station and click “View.”

Instead of going straight to the transmitter information screen, you are given information about the facility, the reference point coordinates and reference distance. Across the top are tabs showing the various station data records associated with the record. Click one.

Station Data: localhost/WVPT

**DTS Info** | Reference | Site 1 | Site 2 | Site 3

Service: TV digital DTS    Facility ID: 60111    Record ID: CD8S TV 2015/10/20 UCM 1551091    Country: U.S.

Call Sign: WVPT    Channel: 11 201 MHz    Status: LIC    City: STAUNTON    State: VA

File Number: BLEDT20130214ACP    Zone: I    Freq. Offset: (none)    Emission Mask: (n/a)    Site Number: 1

Latitude (NAD27): N 38° 9' 54.00"    Longitude (NAD27): W 79° 18' 51.00"

Height AMSL, m: 1333.0    HAAT, m: 689.0    Peak ERP, kW: 10.0    Azimuth Pattern: MCI-SERIES 953422 Orient. 0.0

Elevation Pattern: MCI-SERIES 953422    Elec. Tilt: 1.00    Mech. Tilt: 0.00    Tilt Orient.: 0.0

☒ May use generic pattern when needed

Add Site    Remove Site    Close

Now you see the normal screen for viewing or editing a record in TVStudy. You may view the record in the same way that you would for any non-DTS facility.

When you create or duplicate a DTS, you will use a similar interface; make note of the “Add Site” and “Remove Site” buttons at the bottom left.

## Managing Study Templates

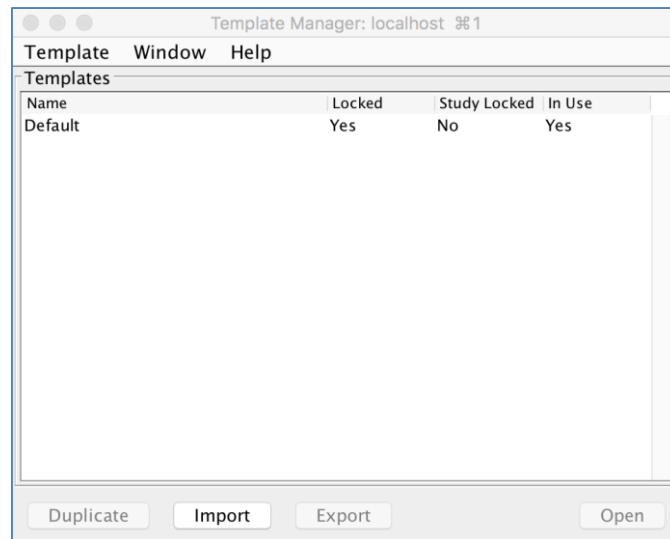
TVStudy comes with a default template with typical study parameter settings; however, if you have a set of parameters that you would like to use regularly, you may want to consider creating a customized template for your study. Once you've created or imported a custom template, you will have the option of selecting it when you create a study, so you do not have to manually adjust the various study parameters.

### *Creating a Study Template*

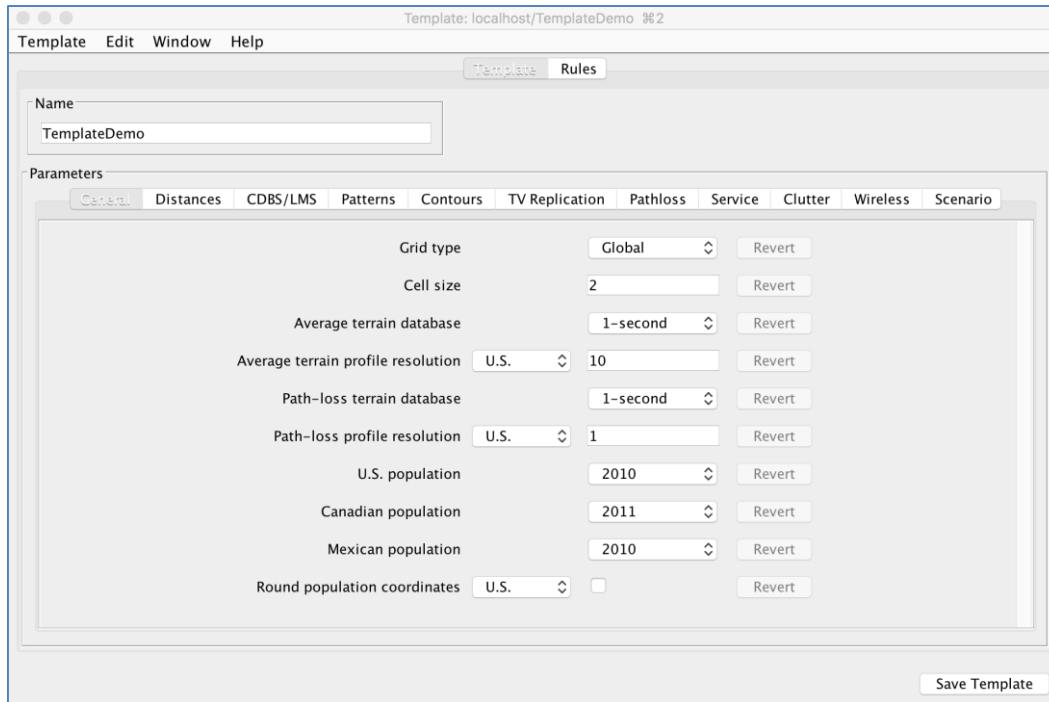
There are two ways to create a study template.

One way is to use the parameters of an existing study as your template. Enter the Study window with the study whose parameters you wish to use as your template and select "Save Study Template" from the Study dropdown menu. Give your template a name, and then click "OK."

The other way is to use the Template Manager. From the Study Manager window, open the Database menu and click "Template Manager".



Click the line named "Default" and click the "Duplicate" button.

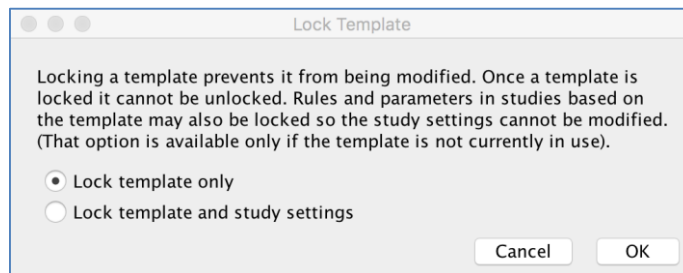


After providing your new template with a name, you are presented with an interface like that in the Study window where you can set the rules and parameters as desired. When finished, simply click “Save Template” at the bottom right.

### ***Locking a Study Template***

The purpose of locking a template is to ensure that the study parameters and interference rules defined by the template cannot change in the future, so study results will remain consistent and comparable over time. There are two lock levels, and the second is more restrictive than the first. Once a template is locked it cannot be unlocked, nor can the lock level be changed.

To lock a study template, open the template in the Template Manager. Then click the Template menu and click on “Save and Lock”.



TVStudy will then ask how you want the template locked.

**Lock template only** – The first lock level prevents the template from being edited. Any new study using a locked template will have the same initial/default parameters and rules as any past study using that template. However with this first lock level the parameters and

rules may still be edited within studies using the template, so individual studies can still be customized. A template may be locked at the first level even if existing studies are using the template.

**Lock template and study settings** – This lock level also prevents the template from being edited as above, but in addition it prevents the parameters and rules from being edited within any study using the template. Using a template locked at the second level means the parameters and rules are always exactly the same in every study using the template; the settings cannot be changed. This provides the highest level of assurance that study results will not vary due to parameter or rule changes. A template cannot be locked at the second level if any existing studies are using the template.

That restriction is necessary to support multi-user installations of TVStudy where an administrator determines the study configuration for all users. This also allows results for studies run through the web interface to be cached, since the results remain valid as long as the template is not changed.

**Note:** A template must be locked with “Lock template only” in order to be used in an interference check study. Neither a study locked with “Lock template and study settings” nor an unlocked template can be used. Additionally, since the wireless frequency and bandwidth are template settings, wireless interference templates should be either unlocked or locked with the “Lock template only” setting unless users are sure the same frequency and bandwidth are required for every study.

### ***Exporting or Importing a Study Template***

You can also share a study templates with others. To do so, click the template you wish to export, and then click “Export.” You are now prompted to give the study template file a name. Do so, and then click “Export.” You can now share your study template with others.

To import a study template that has been shared with you, click “Import,” then navigate to the location where the template is saved. Select the desired template file, then click “Import.” The study template will now be shown in the Template Manager window and be available for you to choose when creating studies.

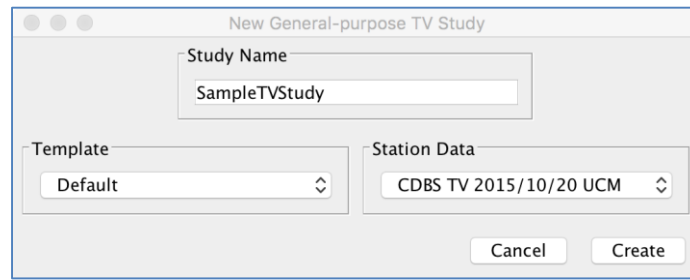
### ***Deleting a Study Template***

If a template is not in use for any studies, it is possible to delete the template. To do so, simply click the template within the Template Manager, then from the Template menu, click on “Delete”.

## Creating a New General Purpose Study

General purpose studies can be used to study coverage and interference between either groups of TV stations or groups of FM stations. The example provided here will cover TV stations; however, a short section explaining the differences that an FM station presents can be found on page 41.

To begin, choose “General-purpose TV” or “General-purpose FM” from the “New study” drop-down menu at the bottom left corner.



This is the interface for creating a general purpose study. In “Study Name,” choose a name for your study. You will want to avoid special characters and limit the length to a reasonable number of characters, since this name is used to create the path for your output files.

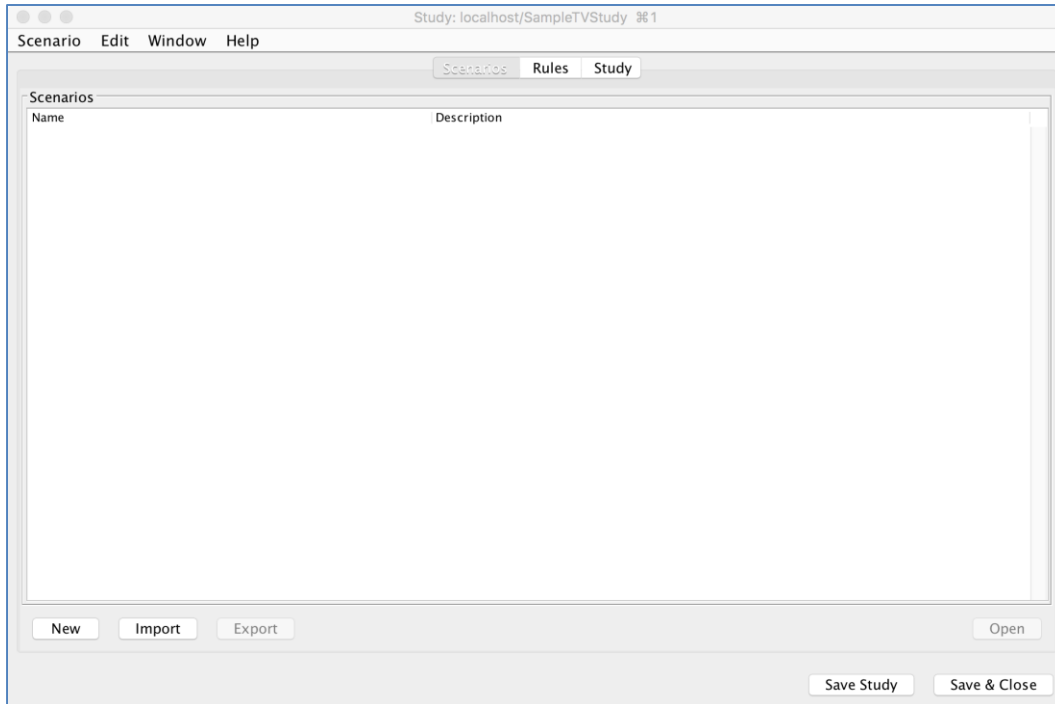
At the left, you must choose a template to use. The Default template will always be present. Additional templates may be added to allow you to pre-select parameters for your study. The FCC may distribute templates for specific types of studies to help ensure that TVStudy users obtain consistent results. Learn how to create and manage study templates on page 19.

At the right, you may choose a CDBS/LMS dataset to use as the default for the study. Learn how to import and manage datasets on page 8.

When you’re satisfied with your name, template, and dataset, click “Create.”

## Creating a New Scenario

Once a study has been created, we can turn to the Study window. There are three tabs in this window: Scenarios, Rules, and Study.



**Key concepts:** A “study” is a set of parameters that are used to analyze stations. A “scenario” is a specific set of stations to be considered. Each scenario is independent of the other scenarios, but utilizes all of the parameters as specified in the study.

The first step is to create a new scenario, which is done using the Scenarios tab. Begin by clicking “New” at the bottom left corner.

You will be prompted to give the scenario a name. As with the study name, you will want to avoid special characters and limit the length to a reasonable number of characters, since this name is used to create the path for your output files. Then click “OK.”

Scenario: localhost/SampleTVStudy/SampleTVScenario %2

Station Edit Window Help

Scenario Name  
SampleTVScenario

Scenario Description

Stations

D...	Und	Call Sign	Channel	Svc	Status	City	State	Facility ID	File Number	Coun...
------	-----	-----------	---------	-----	--------	------	-------	-------------	-------------	---------

Filter

(all Call Sign) (all Channel) (all Svc) (all City) (all State) Clear

Add One Add Many Remove View

You are given a blank “Scenario” window. The description field is a place to store notes and details about this scenario for your own future reference. The description is not only shown here, but also in the Study window when looking at your scenarios.

**Key concepts:** There are two types of stations you can add to a scenario. A “desired” station is one that will be evaluated for coverage and interference to the coverage area. An “undesired” station is one that will only be a potential interference source for desired stations. You can (and normally should) evaluate a station as both desired and undesired at the same time, such that a station evaluated for coverage and incoming interference can also cause interference to other stations, though there may be cases in which a station should be only one or the other. Each scenario requires at least one desired station.



## Adding Station(s) to a Scenario

There are two ways to add stations to a scenario.

### *Adding Individual Stations or New Stations*

To add one station at a time, click “Add One” at the bottom left corner.

The Add Station window shown strongly resembles the View Station Data window detailed on page 10 and can be operated in the same way. The key difference here is the added functionality at the bottom which allows records to be editable or replicated, and of course the “Add” button which places the record into the scenario. For more information on editing and replicating records, see page 32.

Add Station: localhost/SampleTVStudy/SampleTVScenario

Station Data: CDBS TV 2015/10/20 UCM (default) Record ID: File Number:

Call Sign: WRC Channel: Service: (any) Status: (any) Facility ID:

City: State: Add SQL ☐ Include archived Search Clear

3 records

Type	Call Sign	Channel	Svc	Status	City	State	Facility ID	File Number
CDBS TV	WRCB	D13 213 MHz	DT	LIC	CHATTANOOGA	TN	59137	BLCDT20110729ACZ
CDBS TV	WRCF-CD	D35 599 MHz	DC	LIC	ORLANDO	FL	10549	BLDTA20130705AAR
CDBS TV	WRC-TV	D48 677 MHz	DT	LIC	WASHINGTON	DC	47904	BLCDT20000216AAT

Filter: (all Call Sign) (all Channel) (all Svc) (all City) (all State) Clear

View Duplicate Export Save Import New

☐ Allow editing ☐ Replicate Replication Channel:

Close Add

One minor difference from the behavior of the View Station Data window is that you may still use the “New” button to create a new record or the “Import” button to import a record, but you are not required to then save the record to the User records database. If you do wish to save your record to the User records database, simply click “Save” before clicking “Add”. If not, simply create the record and click “Add” without first clicking “Save”.

If you are using an existing record from a dataset, once you select the record that you wish to add to your scenario and choose any editing or replication options, click “Add” in order to add the station to your scenario. The Add Station window will remain open to allow you to add additional individual stations, or you may click “Close” to return to the Scenario window.

Note that you can add records from datasets other than the one associated with the study. These records are added to the study itself and not to the User records database.

Scenario: localhost/SampleTVStudy/SampleTVScenario %2

Station Edit Window Help

Scenario Name  
SampleTVScenario

Scenario Description

Stations

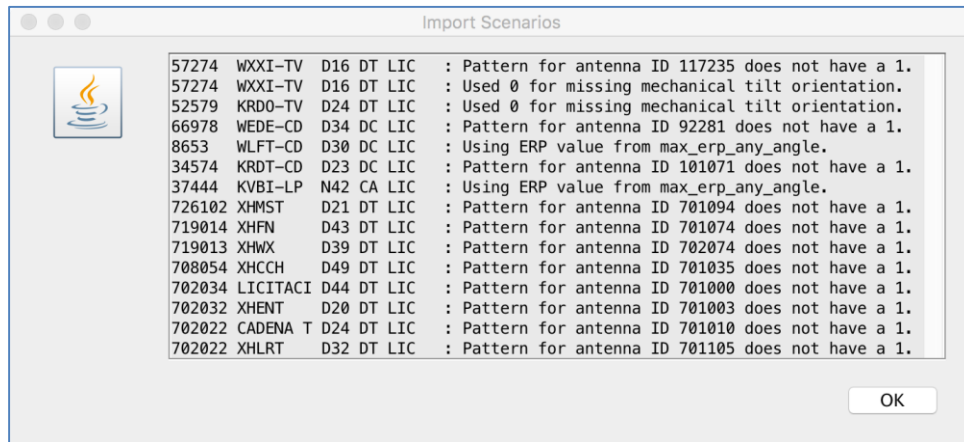
D...	Und	Call Sign	Channel	Svc	Status	City	State	Facility ID	File Number	Coun...
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	WRC-TV	D48 677 M...	DT	LIC	WASHINGTON	DC	47904	BLCDT20000216AAT	US

Filter  
 (all Call Sign) (all Channel) (all Svc) (all City) (all State) Clear

Add One Add Many Remove View

TVStudy will warn you of any unusual conditions it encounters (see page 28) and then add the station to your scenario. By default, stations added in this method are assumed to be both desired and undesired, which is shown in the above Scenario window. To make it undesired only, uncheck the box in the “Des” (Desired) column. To make it desired only, uncheck the box in the “Und” (Undesired) column. Unchecking both boxes will omit the station from being evaluated.

## CDBS/LMS Data Warnings



CDBS/LMS data warnings will not prevent execution of a study; they are provided to alert you to potentially anomalous conditions that may affect the results of the study. Each warning message includes the facility ID, call sign, channel, and status of the record that triggered the warning.

**Used default for missing ERP/HAAT** – If the search returns one or more Mexican allotments missing values for ERP and/or HAAT, TVStudy warns you that it is defaulting to the values you assigned when the study was created.

**Derived missing AMSL from HAAT** – If a station or allotment is missing its antenna radiation center height above mean sea level (RCAMSL), TVStudy will calculate it from the height above average terrain (HAAT) value using the selected terrain database. This should only appear on non-US records.

**Converted ERP from dBk to kilowatts** – If a station has an ERP less than or equal to 0, it is assumed the ERP was entered in dBk instead of kW, and the value is converted to kilowatts.

**Using ERP value from max\_erp\_any\_angle** – When using CDBS data, if a station has a value in the max\_erp\_any\_angle field greater than that of the effective\_erp field, TVStudy will use the max\_erp\_any\_angle value.

**Transposed mechanical tilt parameters** – Some stations with mechanical beam tilt have reversed values for the mechanical tilt (depression) angle and the tilt orientation (azimuth). If a record has a tilt value greater than 11.1 degrees, TVStudy will swap the values.

**Ignored out-of-range electrical/mechanical tilt** – The value in the noted field is less than -10 or greater than 11.1 degrees. TVStudy substitutes a value of 0.

**Used 0 for missing mechanical tilt orientation** – The mechanical tilt is non-zero but the tilt orientation is 0, which may mean that the tilt orientation (azimuth N degrees ET) was not entered in CDBS/LMS. This may not be an error if the tilt orientation is actually toward N 0 degrees ET. The user should independently verify the correct parameters and edit the record if necessary.

**Antenna ID <#> not found** – No pattern data exists for the station’s antenna ID number. TVStudy assumes the station is omni-directional.

**Pattern does not have a 1** – Some antenna horizontal plane (azimuth) patterns in CDBS/LMS are missing a 1.0 maximum relative field point, usually because a station has its maximum at a value between the azimuth values supported by CDBS/LMS (*i.e.*, every 10 degrees). TVStudy warns you about this condition, but takes no corrective action.

**Pattern for antenna ID <#> is bad, <msg>** – Some antenna horizontal plane (azimuth) patterns in CDBS/LMS contain errors (listed below) and TVStudy assumes the antenna is omni-directional:

**Azimuth out of range** – Pattern had azimuth(s) less than 0 or greater than 359.999.

**Duplicate azimuths** – Pattern had two or more field values given for the same azimuth.

**Relative field out of range** – Pattern had field value(s) less than or equal to 0 or field value(s) greater than 1.

**Not enough points** – Pattern had fewer than two points.

**Elevation antenna ID <#> not found** – No data exists for the station’s elevation antenna ID number. TVStudy applies a generic pattern, if allowed. If the pattern is supposed to be a matrix pattern, TVStudy also assumes the station is omni-directional.

**Elevation pattern does not have a 1** – Some antenna elevation patterns in CDBS/LMS are missing a 1.0 maximum relative field point, usually because the antenna is at an odd rotation but the data is entered only every 10 degrees. TVStudy warns you about this condition, but takes no corrective action.

**Elevation pattern for antenna ID <#> is bad, <msg>** – Some antenna elevation patterns in CDBS contain errors, and TVStudy instead applies a generic pattern, if allowed. (By default, the generic pattern is not allowed for wireless records.) If the pattern is supposed to be a matrix pattern, TVStudy also assumes the station is omni-directional and appends “**at azimuth <#>**” to the end of the message.

**Depression out of range** – Pattern had elevation angle(s) outside the range  $-90 \leq \theta \leq 90^\circ$ .

**Duplicate depression angles** – Pattern had two or more field values given for the same elevation angle.

**Relative field out of range** – Pattern had field value(s) less than or equal to 0 or field value(s) greater than 1.

**Pattern data not found** – Pattern data was not successfully loaded.

**Not enough points** – Pattern had fewer than two points.

**Important:** Warning messages will only appear once for a given CDBS/LMS record in a given study; if the same record is used again in a different scenario, the warnings do not appear.

## Adding Multiple Stations with a Search

It is not necessary to add stations one at a time. You can add multiple stations at once using a search function. To access this, click “Add Many” at the bottom left corner of the scenario window.

There are four common search methods shown on this screen, along with the button to Add SQL.

At the top left, you can choose from which dataset you wish to add stations to the scenario. Users may now add stations from any imported dataset into a given study.

Immediately below that, you can choose whether the stations you seek to add here are desired or undesired stations. If you choose to add undesired stations, only stations that meet the rules to be considered for your desired stations will be added, regardless of the other parameters. For example, if you only have desired stations in Texas and you set TVStudy to only search for undesired stations in Canada, TVStudy will return no results. This also means that you must have at least one desired station in your scenario in order to add undesired stations.

Also note the three checkboxes at the left side of the window.

**Disable all MX checks** – This option disables all mutual exclusivity (MX) checks in the software. Checking this box is not recommended unless you are specifically checking two stations at the same location and channel. Any stations added with this checkbox selected are added as desired, but not undesired, to prevent any stations from receiving excessive interference.

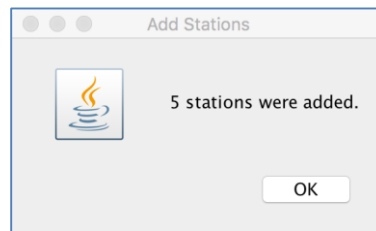
**Prefer operating facilities** – By default, this search window prefers the “newest” record in CDBS (*i.e.*, applications outrank construction permits outrank licenses). Checking “Prefer

operating facilities” flips the order. A pending license will outrank a license will outrank a construction permit will outrank an application.

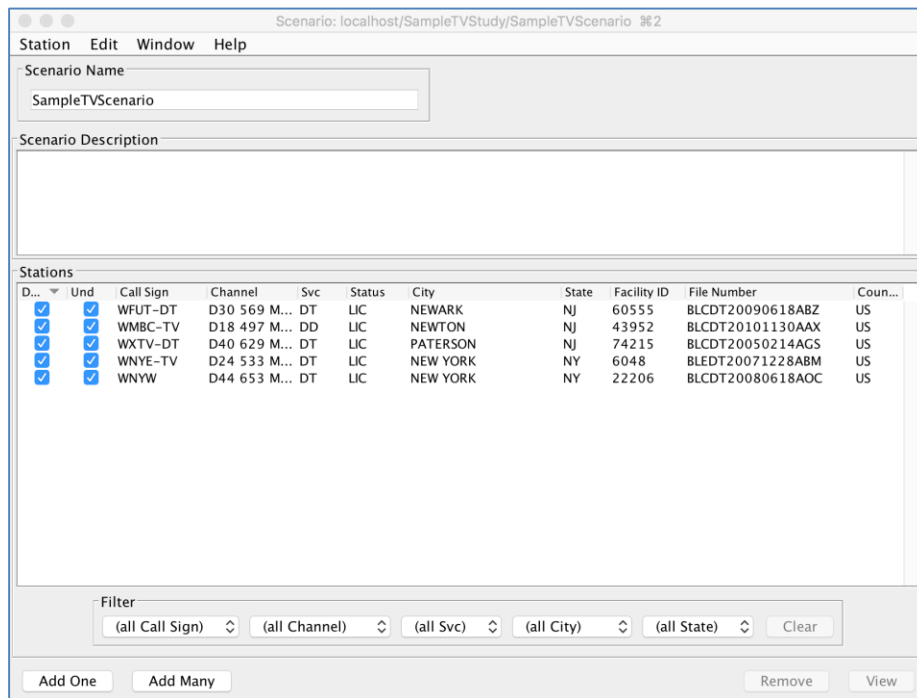
**Add stations as desired-only** – By default, stations added with the “Desired stations” search type are automatically added as both desired and undesired. If you check this box, the records will be added as desired only.

When finished, click “Add”.

After reviewing CDBS/LMS data warning messages (see page 28), if any, click “OK.”



TVStudy then tells you how many stations it found. Click “OK,” and now you will see the stations you selected appear in your scenario.



By clicking and dragging, or by using the usual method for your operating system to select multiple items, you can remove the selected stations from the scenario by clicking the “Remove” button at the bottom right, or modify their desired or undesired status all at once using the options in the Edit drop-down menu.

## Modifying and Replicating Station(s) in a Scenario

One way of providing additional flexibility when studying stations in TVStudy is to allow modification of a station's engineering parameters.

### Modifying and Reverting Stations

To view details about a record, click "View" at the bottom right corner of the Scenario window.

Station Data: localhost/SampleTVStudy/SampleTVScenario/WRC-TV

Service TV digital	Facility ID 47904	Record ID CDBS TV 2015/10/20 UCM 492135	Country U.S.
Call Sign WRC-TV	Channel 48 677 MHz	Status LIC	City WASHINGTON
State DC	File Number BLCDT20000216AAT	Zone I	Freq. Offset (none)
Emission Mask (n/a)	Site Number 0	Latitude (NAD27) N 38 ° 56 ' 24.00 "	
Longitude (NAD27) W 77 ° 4 ' 54.00 "		Height AMSL, ... 312.0	HAAT, m 242.0
Peak ERP, kW 813	Azimuth Pattern (none) Orient. 0.0 View		
Elevation Pattern (none) Elec. Tilt 0.75 Mech. Tilt 0.00 Tilt Orient. 0.0 View <input checked="" type="checkbox"/> May use generic pattern when needed			

Close

Note that the parameters in this window are grayed out and cannot be edited; this is a feature of TVStudy. An entry that cannot be edited is known to be consistent across multiple scenarios. As such, any calculations made about its coverage and/or interference can be cached and reused in other scenarios in the study. However, it is also possible that the values in CDBS/LMS may not be what you wish to use in a given scenario. By clicking "OK" and going back to the Scenario window, you can choose "Allow Editing" from the Station drop-down menu and edit the record.

The appropriate window opens and you can make the edits you wish to the relevant parameters in the record.



Station Data: localhost/SampleTVStudy/SampleTVScenario/WRC-TV

Service TV digital	Facility ID 47904	Record ID CDBS TV 2015/10/20 UCM 492135	Country U.S.
-----------------------	----------------------	---	-----------------

Call Sign WRC-TV	Channel 48 677 MHz	Status LIC	City WASHINGTON	State DC
---------------------	-----------------------	---------------	--------------------	-------------

File Number BLCDT20000216AAT	Zone I	Freq. Offset (none)	Emission Mask (n/a)	Site Number 0
---------------------------------	-----------	------------------------	------------------------	------------------

Latitude (NAD27) N 38 ° 56 ' 24.00 "	Longitude (NAD27) W 77 ° 4 ' 54.00 "
---	---

Height AMSL, ... 312.0	HAAT, m 242.0	Peak ERP, kW 813	Azimuth Pattern (none) Orient. 0.0 Edit
---------------------------	------------------	---------------------	--

Elevation Pattern (none) Edit	Elec. Tilt 0.75	Mech. Tilt 0.00	Tilt Orient. 0.0
-------------------------------------	--------------------	--------------------	---------------------

☒ May use generic pattern when needed

Cancel Save

Some values cannot be changed, such as the country or service, but the other values can be adjusted as desired. Note that if you set the "Height AMSL" field to "-999", TVStudy will compute the height AMSL from the HAAT value.

When you're finished, click "OK".

Scenario: localhost/SampleTVStudy/SampleTVScenario 2

Station Edit Window Help

Scenario Name  
SampleTVScenario

Scenario Description

Stations

D...	Und	Call Sign	Channel	Svc	Status	City	State	Facility ID	File Number	Coun...
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	WRC-TV	D48 677 M...	DT	LIC	WASHINGTON	DC	47904	BLCDT20000216AAT	US

Filter

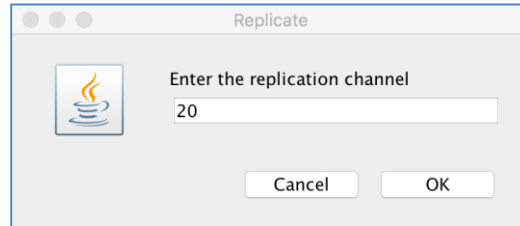
(all Call Sign) (all Channel) (all Svc) (all City) (all State) Clear

Add One Add Many Remove Edit

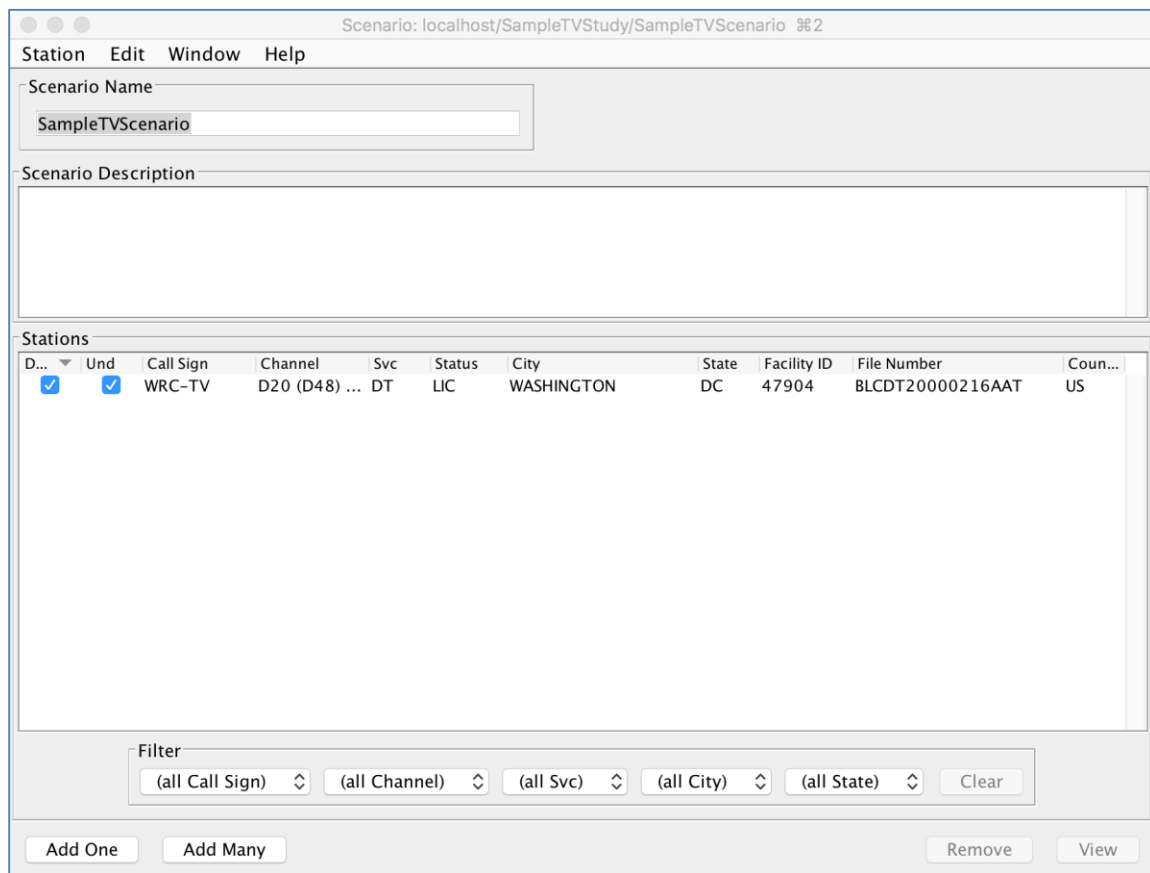
Editable records appear in **green** in the Scenario window. If you want to revert back to the original unedited record values, choose “Revert” from the Station dropdown menu.

## Replicating Stations

A feature of TVStudy is that you can choose to replicate a station's coverage on a different channel. To do so, select "Replicate..." from the Station dropdown menu.



Enter the channel you wish to replicate to and click "OK."



In the above example, you can see that the "Channel" column now shows D20 as the replication channel, while (D48) appears in parentheses to show the station's original channel number.

Replication of either an analog or digital record will produce a digital replication. TVStudy will not replicate stations to new analog channels under any circumstance.

Station Data: localhost/SampleTVStudy/SampleTVScenario/WRC-TV

Service TV digital	Facility ID 47904	Record ID CDBS TV 2015/10/20 UCM 492135	Country U.S.
Call Sign WRC-TV	Channel 20 509 MHz replicated from D48	Status LIC	City WASHINGTON
File Number BLCDT20000216AAT	Zone I	Freq. Offset (none)	Emission Mask (n/a)
Site Number 0	Latitude (NAD27) N 38 ° 56 ' 24.00 "	Longitude (NAD27) W 77 ° 4 ' 54.00 "	
Height AMSL, ... 312.0	HAAT, m 242.0	Peak ERP, kW 0.001	Azimuth Pattern (none) Orient. 0.0 View
Elevation Pattern (none) View			
		Elec. Tilt 0.75 Mech. Tilt 0.00 Tilt Orient. 0.0	<input checked="" type="checkbox"/> May use generic pattern when needed

Close

If you view the replicated record prior to running a study, you will note that the ERP is now listed as 0.001 kW. The replication power level is not determined until runtime. TVStudy, upon running the study, will increase the ERP as needed until the station is replicated on the new channel, after which viewing this record will show the resulting ERP.

As with Editable records, choosing "Revert" from the Station menu will return the replicated station to its original channel.

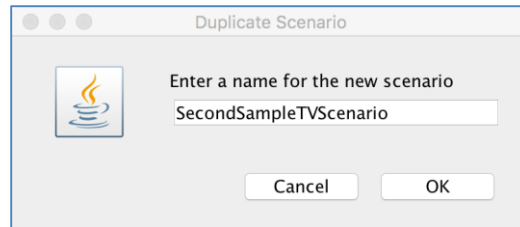
When you are satisfied with your scenario, close the Scenario window and return to the Study window.

## Managing Scenarios

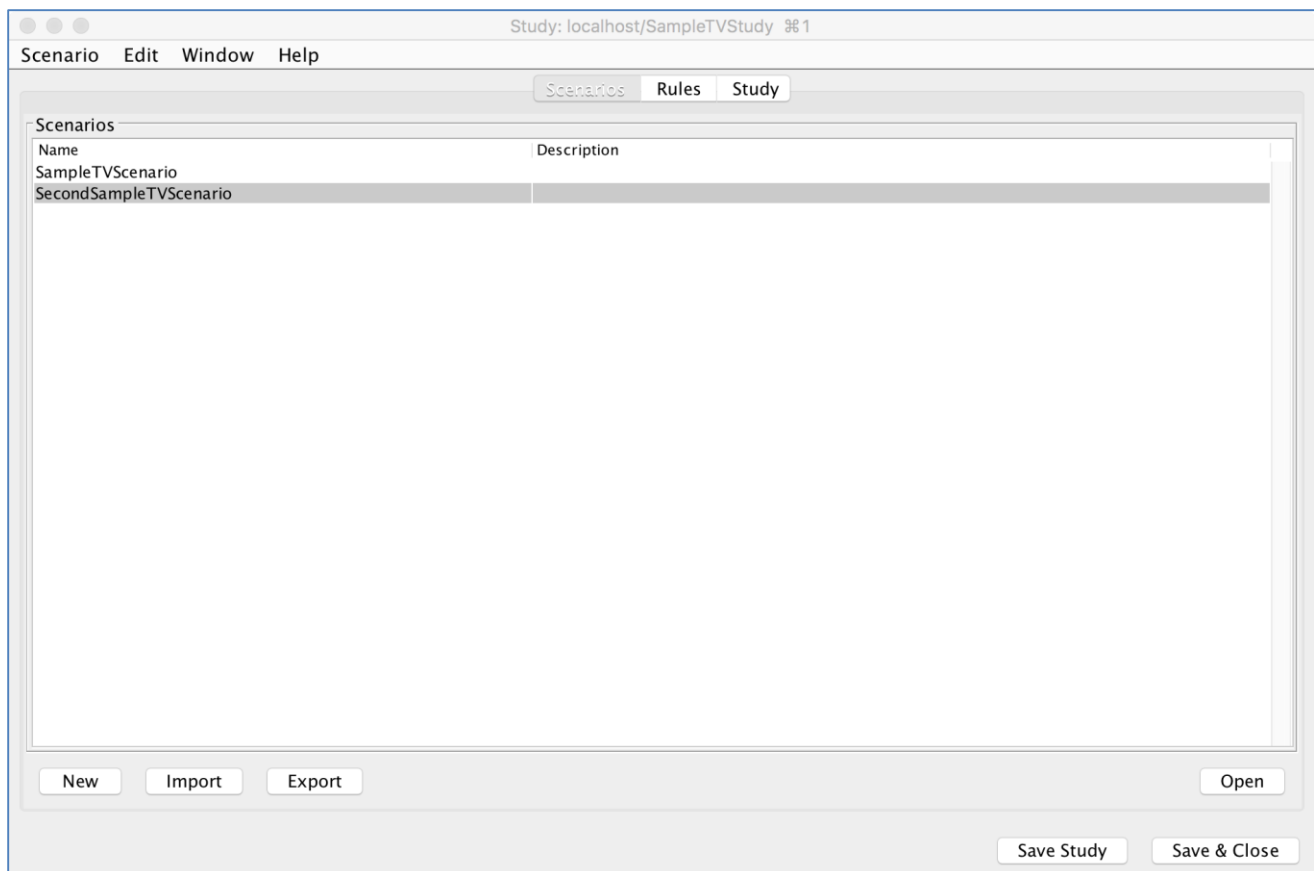
### *Duplicating a Scenario*

One useful feature in TVStudy is the ability to duplicate a scenario.

Choose the “Duplicate...” option from the Scenario dropdown menu.



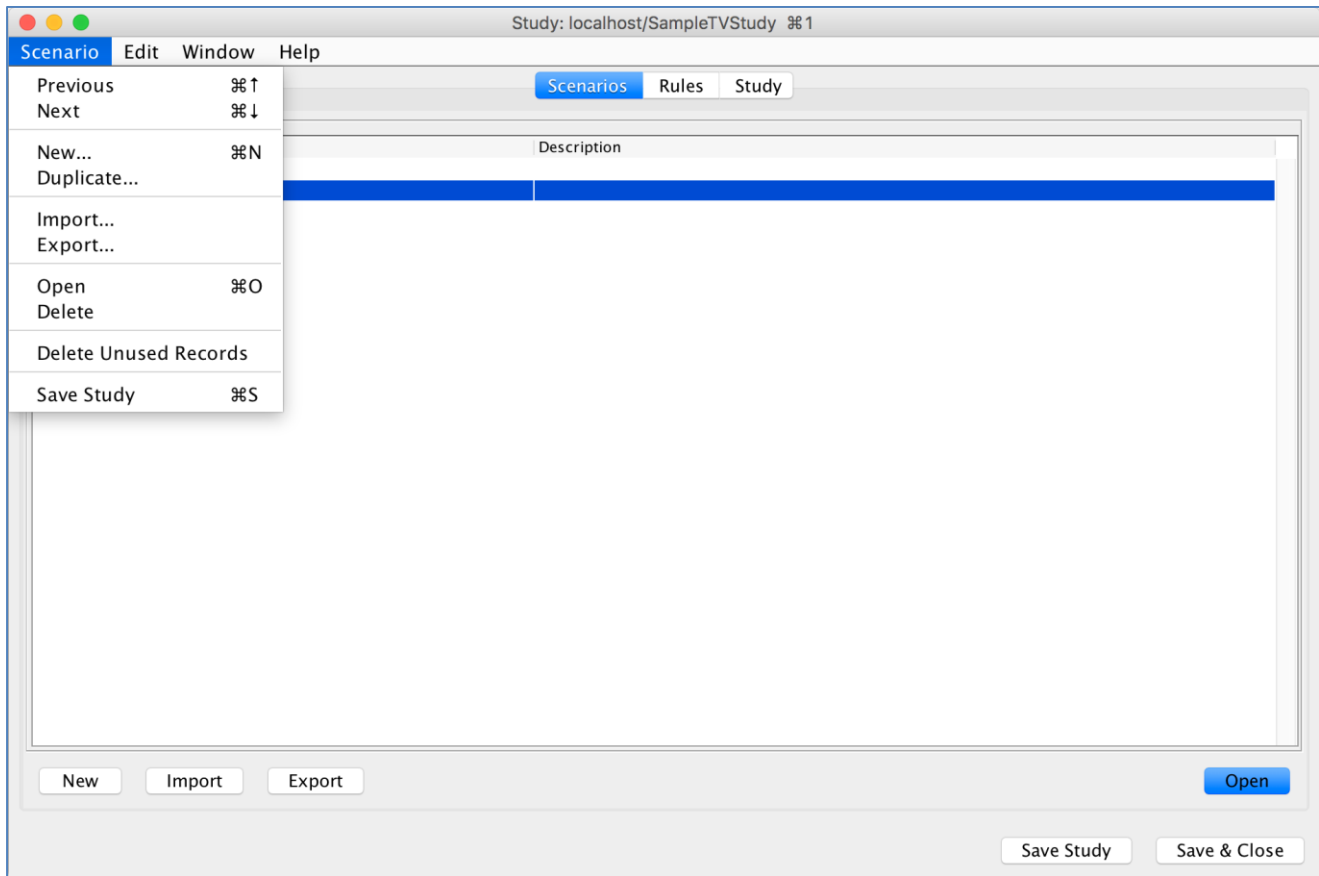
You are prompted to give the new scenario a name. You will want to avoid special characters and limit the length to a reasonable number of characters, since this name is used as part of the path for your output files. TVStudy immediately opens the new duplicate scenario for you, on the assumption that you will immediately wish to make some modifications.



When finished, close the scenario and both scenarios will be visible in the Study window.

## Importing, Exporting, and Deleting Scenarios

Other useful features are the ability to import, export, and delete scenarios. Importing and exporting scenarios can be useful for comparing the results of a scenario across multiple studies. You can also delete scenarios that are no longer required.



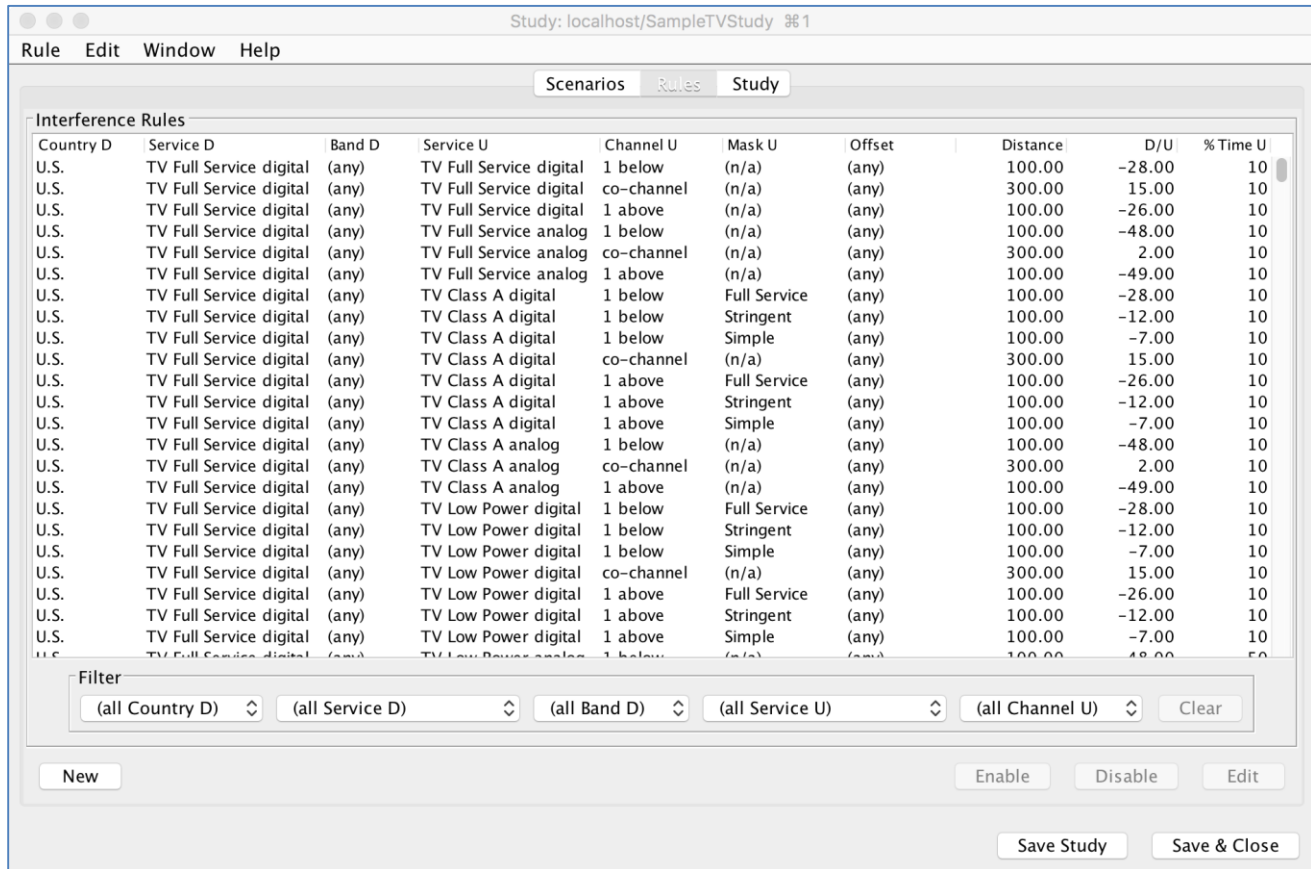
To export a scenario, click “Export” at the bottom left. The file is exported as an XML file, so navigate to where you would like to save it, give it a name, and click “Save.” See Appendix H for details on the XML file format.

To import a scenario, click “Import” at the bottom left. Navigate to where the file you wish to import is located, click on it, and click “Open.”

To delete a scenario, click on the scenario you would like to delete, then select “Delete” from the Scenario dropdown menu.

## Examining the Study Rules

Clicking on the Rules tab will show you all of the rules that are used in this study. These are the values specified in OET Bulletin No. 69 or suggested by the FCC, and are typically not changed. You can filter them, edit them, disable or enable them, and you can change multiple parameters at once using “Enable/Disable by Type” in the Rule menu.



You can filter rules by type in order to more easily locate rules you wish to view or modify. Simply use the dropdowns in the “Filter” area. To remove the filtering, click the “Reset” button at the right.

Study templates also include values for the rules, meaning that if you devise a set of custom rules and then save or export a study template, the rules specified will be included.

## Setting the Study Parameters

To set study parameters, click the “Study” tab.

The screenshot shows the 'Study' tab of the TVStudy application. The window title is 'Study: localhost/SampleTVStudy 1'. The menu bar includes 'Study', 'Edit', 'Window', and 'Help'. There are three tabs: 'Scenarios', 'Rules', and 'Study' (which is active). The 'Study' tab contains the following elements:

- Study Name:** A text field containing 'SampleTVStudy'.
- Study Description:** A large, empty text area.
- Study Parameters:** A section with sub-tabs: 'General', 'Distances', 'CDBS/LMS', 'Patterns', 'Contours', 'TV Replication', 'Pathloss', 'Service', and 'Clutter'. The 'General' sub-tab is active and contains:
  - Grid type:** A dropdown menu set to 'Global' with a 'Revert' button.
  - Cell size:** A text field with '2' followed by 'km' and a 'Revert' button.
  - Average terrain database:** A dropdown menu set to '1-second' with a 'Revert' button.
  - Average terrain profile resolution:** A dropdown menu set to 'U.S.' followed by a text field with '10' and 'pts/km' and a 'Revert' button.
  - Path-loss terrain database:** A dropdown menu set to '1-second' with a 'Revert' button.
  - Path-loss profile resolution:** A dropdown menu set to 'U.S.' followed by a text field with '1' and 'pts/km' and a 'Revert' button.
  - U.S. population:** A dropdown menu set to '2010' with a 'Revert' button.

At the bottom right of the window are two buttons: 'Save Study' and 'Save & Close'.

As with the description field for the Scenario, the description field is a place to store notes and details about this study for future reference. The description is not only shown here, but also in the Study Manager window when looking at your studies.

The Study Parameters section is broken up into tabs, which contain parameters that are generally related to each other. There are many parameters that can be adjusted as desired. It is important to record the parameter values used in a particular study so that it can be duplicated. The parameter values used in a run are memorialized in the TVStudy Settings output file. To see a complete list of these parameters, please see Appendix A.

When finished with your study, click “Save Study” and close the Study window.



## Differences with an FM General Purpose Study

FM general-purpose studies are nearly identical to TV general-purpose studies, with two major exceptions.

### 53<sup>rd</sup> and 54<sup>th</sup> Adjacent Rules

TVStudy has support for 53<sup>rd</sup> and 54<sup>th</sup> adjacent interference calculations. While this is contained in the Rules tab like any other rule, it behaves slightly differently from other rules. While the D/U ratio is given as 0 dB for these cases, that D/U ratio is only triggered if the field strength in the cell for both stations is at least 91 dBu. This value and behavior was determined by the FCC in NPRM FCC 88-87 and R&O FCC 89-64, in docket 86-144.

### IBOC Interference

TVStudy has support for computing interference caused by IBOC transmissions of adjacent channel FM stations, which can be turned on or off with a parameter setting in the Pathloss tab. As such, when viewing or modifying a station, you will see an extra field, as shown in the picture here:

Station Data: localhost/SampleFMStudy/SampleFMScenario/WTOP-FM

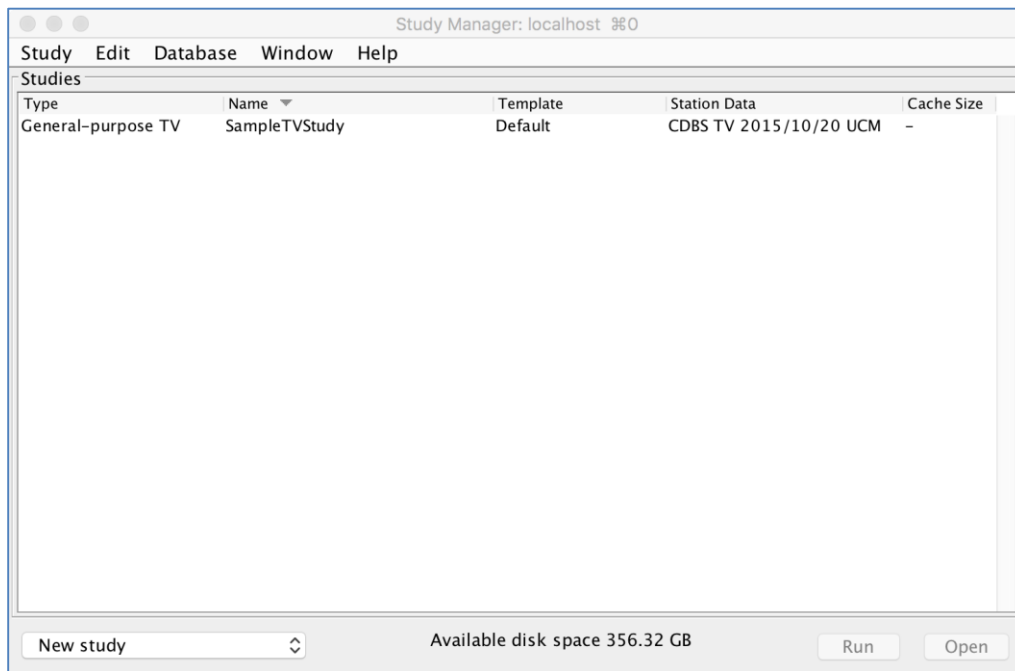
Service FM	Facility ID 11845	Record ID CDBS FM 11/20/2015 (10) 1416869	Country U.S.
Call Sign WTOP-FM	Channel 278 103.5 MHz	Status LIC	City WASHINGTON
		State DC	
Class B		File Number BMLH20110215ABQ	
Latitude (NAD27) N 38° 56' 10.00"		Longitude (NAD27) W 77° 5' 33.00"	
Height AMSL, ... 228.0	HAAT, m 158.0	Peak ERP, kW 44.0	Azimuth Pattern ODD-ODD900205IG Orient. 0.0
		<input checked="" type="checkbox"/> IBOC digital IBOC ERP, kW 2.11	<input type="button" value="View"/>
Elevation Pattern (none) <input type="button" value="View"/>		Elec. Tilt 0.00	Mech. Tilt 0.00
		Tilt Orient. 0.0	
<input checked="" type="checkbox"/> May use generic pattern when needed			
<input type="button" value="Close"/>			

TVStudy uses CDBS to determine whether or not a station is operating with IBOC in order to prepopulate the IBOC digital checkbox for each station added to a scenario. It further attempts to determine the power of the IBOC signal from CDBS records, but if it cannot for any reason, it assumes the default -20 dBc power value.

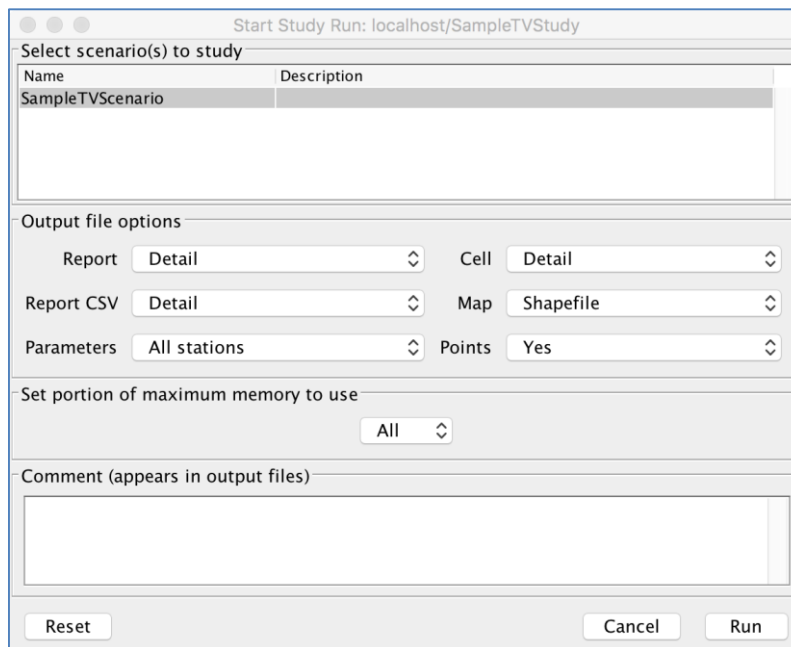
The presence of interference is calculated based on the formula that was used to determine the F(50,10) contour overlap prohibition as proposed by iBiquity and NPR and adopted by the FCC in DA 10-208 (page 6). Using the standard FCC adjacent channel interference rules, this interference is masked up to -14 dBc and only alters results at power levels higher than that value.

## Running Your Study

### Running a General Purpose Study



To run a study, click on the study you wish to execute, then click “Run” at the bottom right corner.



Click on the scenario(s) you wish to run. If you select no scenario(s), TVStudy will do some initial calculations, such as contour projection, and cache the resulting data for future scenario runs. However, this will produce no output data.

You can now select the types of output you would like.

**Report (tvstudy.txt and tvstudy\_settings.txt)** – These are textual files listing all of the stations and their coverage areas, plus all of the study parameters and rules used in the study.

**Detail** – This produces tvstudy.txt files for each scenario.

**Summary** – If several scenarios are run at once, the summary output will list them all in one tvstudy.txt file in a summarized form. (This format is most useful with interference check mode.)

There is only one tvstudy\_settings.txt file, which is the same for both Detail and Summary, which is always output regardless of the choice here.

**CSV (tvstudy.csv)** – Creates CSV files.

**Detail** – This is a detailed CSV output file showing the station's coverage and interference, as well as which stations are causing the interference.

**Summary** – If several scenarios are run at once, the summary output will list them all in one spreadsheet rather across several "Detail" spreadsheets. (See Appendix D.)

**Parameters (parameters.csv)** – Creates a CSV output file listing the parameters used in the study. (See Appendix D.)

**Desired only** – The CSV file contains only desired stations.

**All stations** – The CSV file contains all stations, desired and undesired.

**Cell (tvstudy.cel)** – Creates a text file showing cell-by-cell results for your scenario(s).

**Detail** – This is a highly detailed list of output for every cell evaluated for every station in the scenario, including the D/U ratios, exact study point coordinates, and other values that may be useful for post-processing. This file may be very large. (See Appendix E.)

**Summary** – This is an output which leaves out many of the details of the study except for the population of the cell and whether the cell has service or not. (See Appendix E.)

**Detail CSV** – This is a set of three to five comma separated text files with very detailed information on the calculated field strengths and D/U ratios in every grid cell in the study. The number of files created depends on the type of study being performed. (See Appendix E.)

**Map (various)** – Creates map files for the results of the scenario(s). (See Appendix F.)

**Shapefile** - Creates a set of ESRI ShapeFiles.

**KML** - Creates a set of Google KML files.

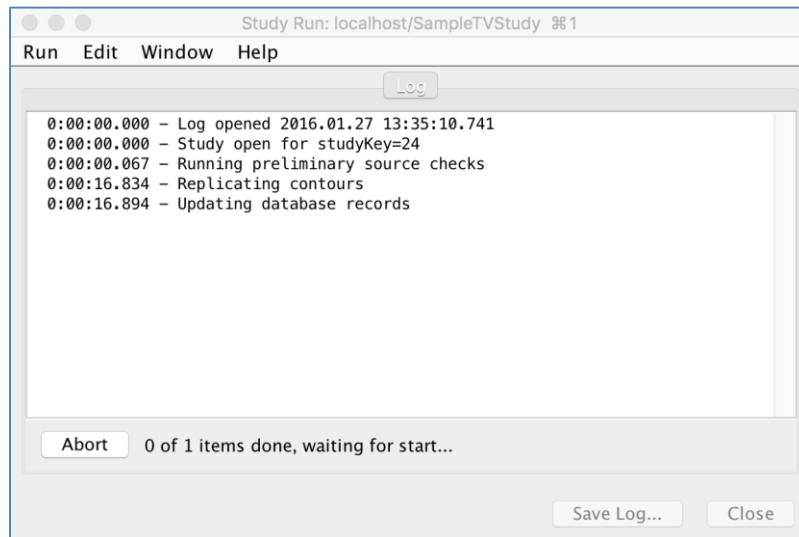
**Points (points.csv)** – Creates a CSV output listing all the cells used in the study along with their populations. (See Appendix D.)

Please note that all outputs featuring geographic coordinates are in the NAD83 format.

You are then able to select the amount of free memory to be used in your study. If you plan to run more than one study at a time, it may be useful to allocate only a fraction of the available memory to a particular run.

You can also add comments to be included in your report, CSV, and/or cell file(s).

When you are satisfied, click “Run.”



The run window is relatively simple. While running, it indicates what it is doing, gives an estimate of how much time may be remaining, and has an Abort button.

**Important:** If you choose to abort a study while it is running, avoid doing so when the last line in the output window reads “Updating Caches” as this can lead to data corruption issues.

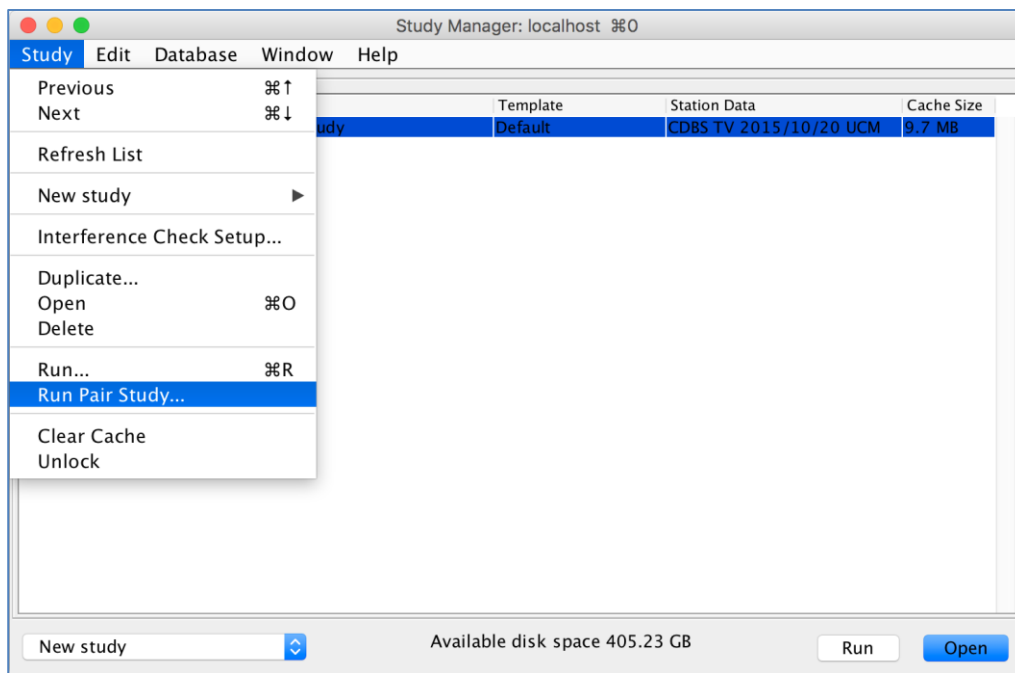
When the run is finished, you can save the contents of the run window to a file by selecting the "Save Output" option. Click “Close” and return to the Study Manager window.

Your output files have been placed in a directory structure within the “out” directory. The folder structure follows the format of `../out/<servername>/<studyname>/<scenarioname>`.

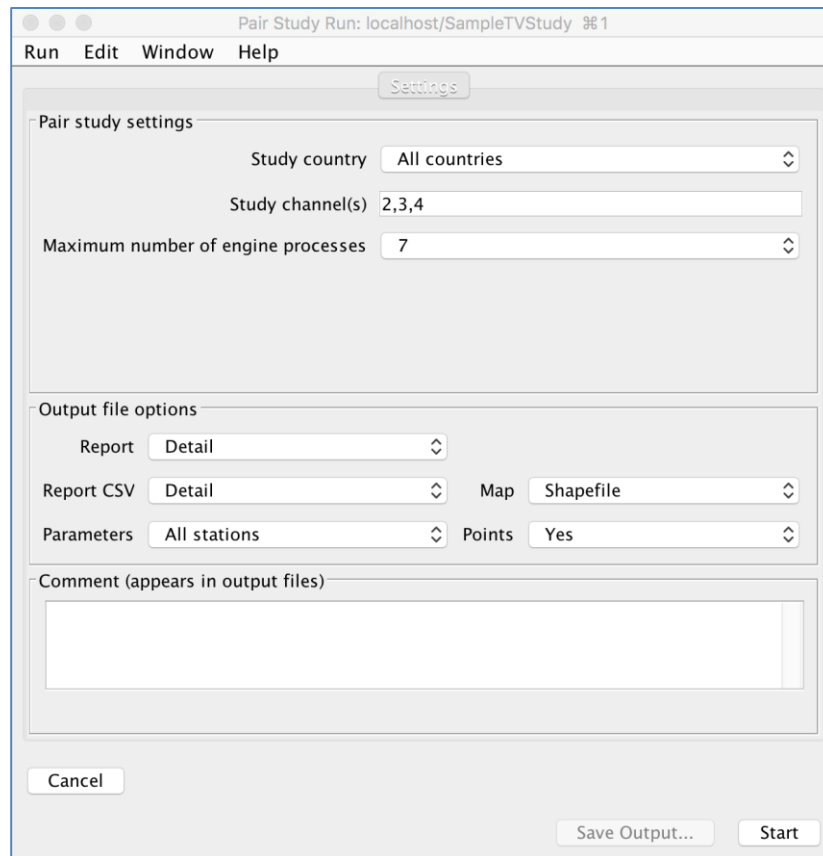
## Running a Pair Study

One of the key features of TVStudy is the ability study arbitrary pairs of stations on one or more specified channels to see whether they can coexist based on some interference criteria. This is called a “pair study.” A pair study takes every pair of stations and studies them on the same channel (co-channel) as well as with each station placed lower-adjacent and upper-adjacent to the other, in order to determine interference levels in each channel relationship. The pair study produces a set of CSV files with a cell-by-cell determinations of service and interference designed to be input into post-processing software. These instructions will show you how to run a pair study. Post-processing these data is not part of TVStudy and is not covered in this manual.

First, in order to successfully run a pair study, your Study must have a single Scenario. In addition, no stations from Guam, American Samoa, or any other location in the southern or eastern hemispheres can be included, and TVStudy cannot run a pair study if any stations north of 73 degrees latitude are included.



In the Study Manager window, choose “Run Pair Study...” from the Study dropdown menu.

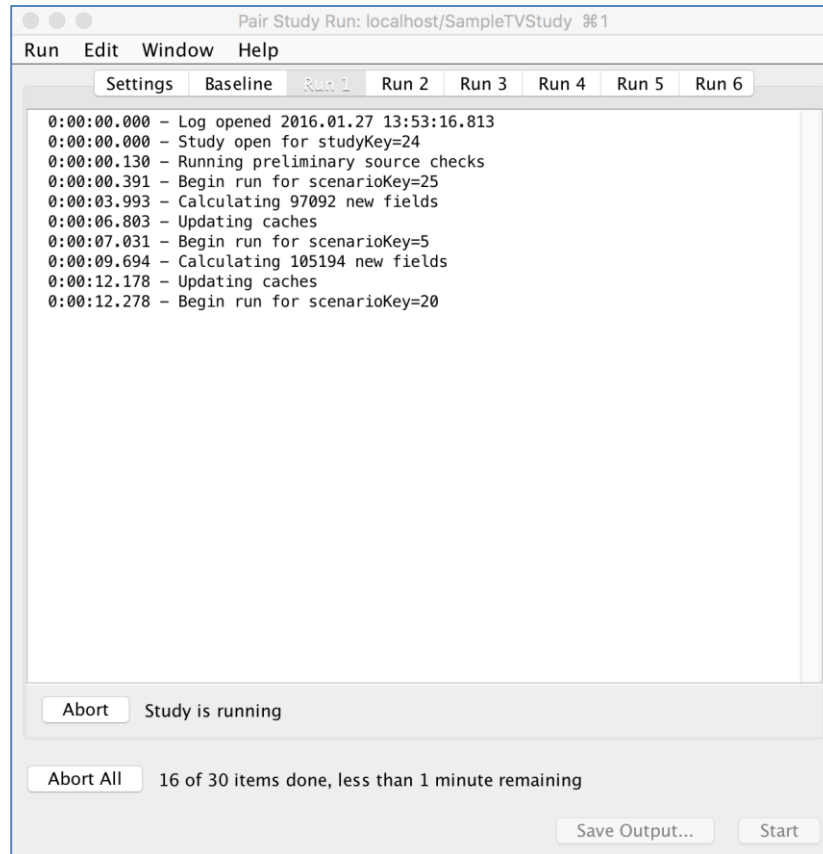


In the Run Pair Study window, enter the country you wish to study (or all countries), the channel(s) on which you wish to run your pair study (these channels are the co-channel study, the associated adjacent channels are determined automatically), and then choose the number of processes you would like to use. TVStudy will offer you as many processes as you have processors or cores as reported by your operating system, and it is recommended that you run at least one less than the maximum number provided, to allow for database accessing overhead without causing the system to slow down. Attempting to run more than 10 channels at a time is not recommended due to various memory constraints. If your computer has a small amount of RAM, more restrictive limits (*i.e.*, fewer than 10 channels) may apply.

The software can also produce the standard Report, CSV, and Map output files for the baseline. The Cell file output is unavailable in a pair study, but the normal pair study output files provide cell-level data. (See Appendix G.)

The pair study may consume as much RAM as is determined to be free by TVStudy. If you try to run other studies while TVStudy is executing a pair study, the software will queue those studies to run after the pair study is complete.

When you are satisfied, click “Start.”



As the pair study runs, you can monitor its progress by clicking the various tabs as they appear. It will first calculate the numbers of stations and pairs to be studied. Then it will run a baseline study of the stations on their original channels to determine existing interference conditions. The software then will then take a sufficiently large run and break it into as many pieces as the number of assigned processes, and will run pair studies for every combination. Finally, the resulting data is post-processed and then output to the appropriate “out” directory, leaving six files which are documented in Appendix G.

When you click “Finish,” the software will restore the database to its normal state.

## Configuring and Creating TV Interference Check Studies

TVStudy has the ability to run TV interference check studies. This is the kind of study that the FCC Media Bureau's *tv\_process* software was previously used to produce for TV application processing, in which new applications can be evaluated to determine whether or not they meet the FCC's interference standard.

### Interference Check Setup

Before running a TV Interference Check study, you first need to set up TVStudy to run these studies in the manner desired. From the Study Manager window, click Study and choose "Interference Check Setup".

In this window, you need to set a few items. At the top left, choose which template you would like your Interference Check studies to use. At the right, choose which dataset to use for the check of proximity to AM station operations.

**(Note:** A template must be locked with "Lock template only" in order to be used in an Interference Check study. Neither a study locked with "Lock template and study settings" nor an unlocked template can be used. See page 20.)

In the second row, select which dataset of stations to use to build your interference check studies in the "Study Station Data" section.

Below that, you can set the percentage of interference to full-power stations (left) and LPTV stations (right) which constitute an interference check failure. By default, these values are set to 0.5% for full-power stations and 2.0% for low-power stations, as defined in the FCC's rules.

At the bottom, you can choose which output file options are selected by default when you run your interference check study.

When you are satisfied with your selections, click "Save" to save your preferences and exit the Interference Check Setup window.

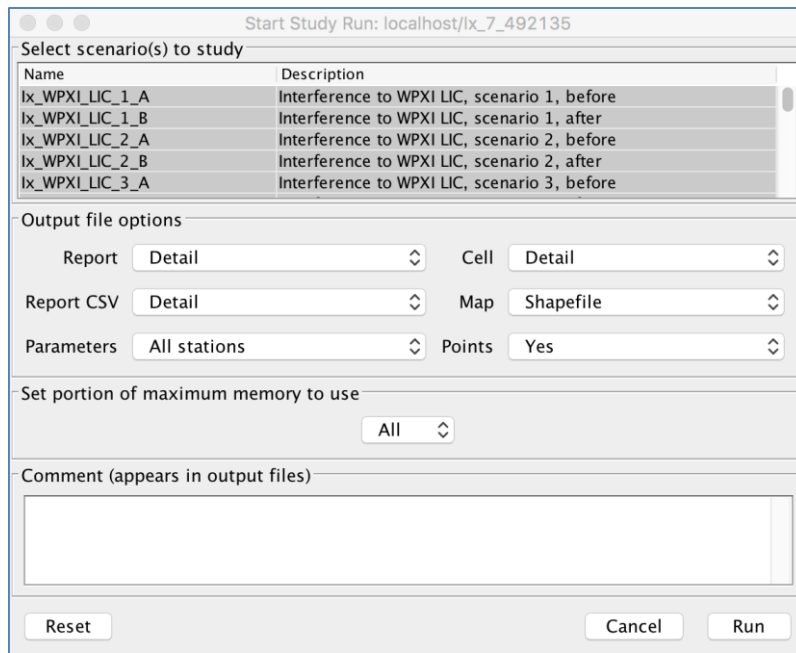


## Creating and Running an Interference Check Study

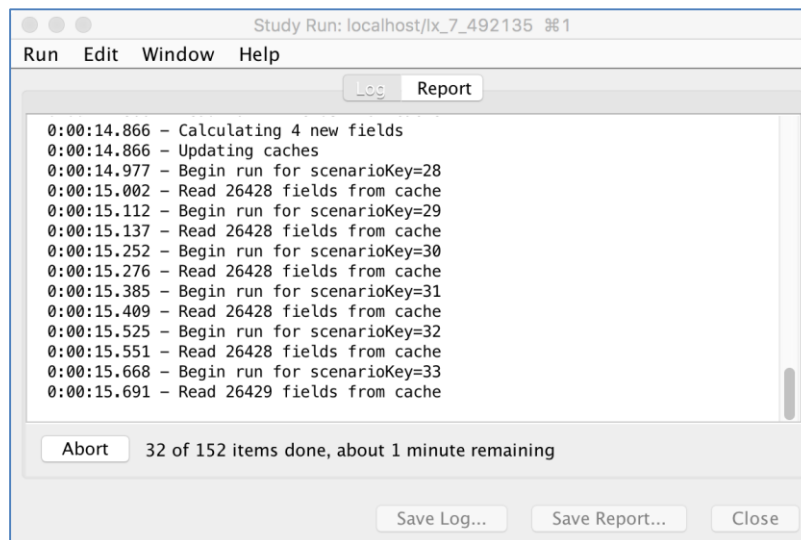
Much of the process of creating and running an interference check study is automated, but you must start the process. To begin, from the Study Manager window, click “New study” and choose “TV interference check”.

The Interference Check Study window strongly resembles the View Station Data window detailed on page 10 and can be operated in the same way. The key difference here is the added functionality at the bottom which allows you to set the study description, cell size, profile resolution, and include or exclude specific records from the analysis. One checkbox allows you to exclude all application records, while another will exclude pending records, and a third will allow you to include records from outside the US. You may also exclude additional records; to do so, put the ARN for each file number to be excluded on a separate line in the “Records to exclude (ARNs)” pane. (As an example, if you wish to exclude BLCDDT-20090714AAW, you would input only 20090714AAW, leaving off the BLCDDT prefix. For LMS-filed records, input the entire file number, for example, 0000003746)

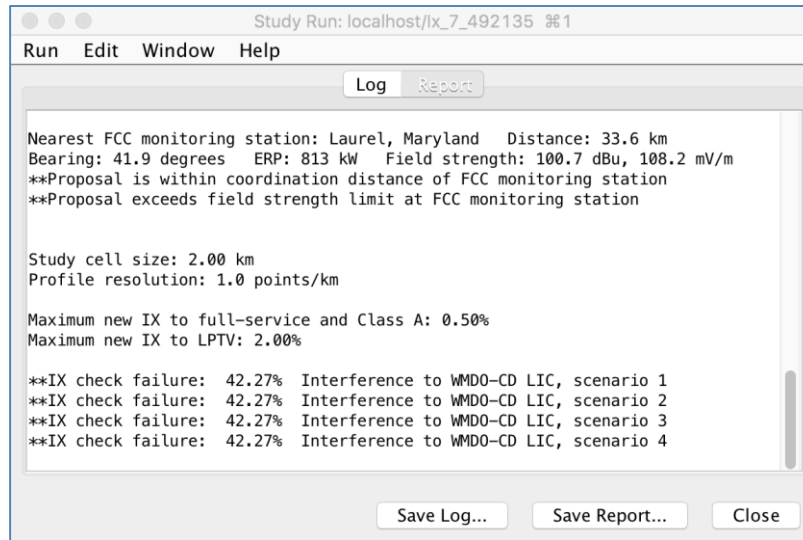
When you are satisfied that you have selected or created the proper record with the proper study settings, click “Start.” TVStudy will then warn you about any data issues it encounters (see page 28) and automatically generate the necessary scenarios. When it is finished, it will present you with the Run window.



TVStudy will have preselected all of the scenarios to run and preset your output preferences based on what you selected in the Interference Check Setup window. When you have verified that you are satisfied with your settings, click "Run".



The run window is similar to that used for general purpose study runs, with a single abort button, but now the window has two tabs.



In addition to the Log tab that is present in general purpose studies, Interference Check mode also has a Report tab, which contains a summary of the results of the coverage study when it is finished. This output mimics the output that *tv\_process* would have provided, including a mention of whether or not an interference check has passed or failed. To save this output, click "Save Report Output..." at the bottom right. You can also save the log file and close the window at the bottom right.

Your output files have been placed in a directory structure within the "out" directory. The folder structure follows the format of `../out/<servername>/<studyname>/<scenarioname>`.

Please note that all outputs featuring geographic coordinates are in the NAD83 format.

## Creating and Running Wireless to TV Interference Studies

Wireless to TV interference studies in TVStudy apply the procedures described in OET Bulletin No. 74<sup>3</sup> to determine interference between wireless and a single victim DTV station.

Culling distances are based on the distance between the closest point on the TV station contour and the location of the wireless site and distances are calculated in TVStudy using the cosine method of calculating distances. If you wish to edit the culling distances, you can do so on the wireless tab of the study parameters so long as the study settings of the study template are not locked.

There are two ways to set up and run a Wireless to TV interference study; via the study wizard or using the advanced wireless to TV study windows.

### *Using the Wireless to TV Study Wizard*

To create a wireless to TV interference study using the study wizard, you will first need to import a wireless site dataset and corresponding wireless antenna dataset. See the “Managing Datasets” on page 8 and Appendix B on page 69 of this manual for information on how to do this.

Once you have imported your wireless/antenna datasets, you are ready to create a new Wireless to TV interference study using the study wizard. To begin, choose “Wireless to TV Interference” from the “New study” drop-down menu at the bottom left corner.

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<sup>3</sup> <https://www.fcc.gov/bureaus/oet/info/documents/bulletins/oet74/OET74.pdf>

At the top of the window, you can search for and choose the victim TV station from any of the existing CDBS/LMS datasets or you can import or create a new a TV station record to serve as the victim TV station. To search an existing dataset, select the dataset from the top drop-down menu and enter any other search criteria. To list all TV stations in a dataset, simply click the “Search” button without entering any other criteria. You can also filter search results using the filter criteria below the search results window.

To import a TV station via XML you can click on the “Import” button and select your XML file with the TV station data. You will be asked to choose an existing CDBS/LMS dataset to resolve any XML references to record IDs. You can also create a new TV user record from this window by clicking on the “New” button and filling in the TV user record form and then clicking “Save”.

Near the bottom of the window, in “Study Name,” type a name for your study. You will want to avoid special characters and limit the length to a reasonable number of characters, since this name is used to create the path for your output files.

Below that, you must choose a study template to use. The Default template will always be present. Additional templates may be added to allow you to pre-select parameters for your study. The FCC may distribute templates for specific types of studies to help ensure that TVStudy users obtain consistent results. Learn how to create and manage study templates on page 19.

Immediately beneath that is a button which will allow you to add a description of your study.

To the right, you must choose a wireless dataset to use to find interferers for the study. Additionally, you can choose whether or not masking TV interference is to be considered and, if so, from which database those interfering stations should be retrieved.

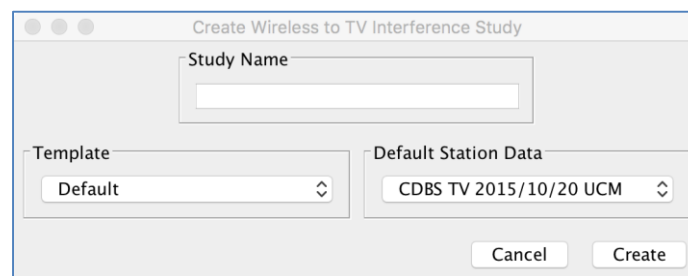
Finally, enter the appropriate wireless frequency and bandwidth to evaluate against the victim TV station in question.

Once you have completed all of the above, click “Start”. TVStudy will automatically set up your Wireless to TV interference study and present you with a Run window. If you have selected a database from which to pull masking TV interferers, your study will include any undesired co-channel or adjacent channel TV stations within the distance specified by the rules in the template. Click “Run” and the study will commence. If you don’t wish to immediately run the study, click “Cancel” and you should now see the study listed in the study window.

### ***Using the Advanced Mode***

If you wish to create a wireless to TV interference study via XML import or create multiple scenarios within the same study, you can use the advanced mode to create an empty study and then add one or more scenarios.

To build a new scenario in the advanced mode, click “New” at the bottom of the Study window and select “Wireless to TV Interference (advanced)”.



Provide a Study name, select the study template to use, and select the CDBS/LMS TV station dataset for the study to use. Once you have done this, click “Create”.

An empty study window will appear, similar to that of the General-purpose study modes. To add a scenario, click on the “New” button at the bottom of the study window. A New Scenario window will appear which allows you to select your victim TV station from any of the existing TV databases. If desired, you can import a single TV station record from an XML file or create a new TV user record. At the bottom of the window, provide a name for your new scenario. Finally, click “Create” at the bottom right corner of the screen to create your new scenario.

Note that once you have selected your victim TV station, you will be unable to remove it from the scenario. The only way to change your victim TV station is to create a new scenario.

Scenario: localhost/SampleWLSStudy/SampleWLSscenario %2

Station Edit Window Help

Scenario Name  
SampleWLSscenario

Scenario Description

Scenario Parameters

Wireless frequency 650

Wireless bandwidth 5

Stations

D...	Und	Call/ID	Channel	Svc	Status	City	State	Facility ID	File/Ref Number	Coun...
<input checked="" type="checkbox"/>	<input type="checkbox"/>	WPXW-TV	D34 593 ...	DT	LIC	MANASSAS	VA	74091	BLCDT20090612AIZ	US

Filter

(all Call/ID) (all Channel) (all Svc) (all City) (all State) Clear

Add One Add Many Remove View

To add interferers to your new scenario, click on the “Add One” or “Add Many” button. Select the database from which you want to import new interfering sites. If you are only adding one new site, enter the search criteria, import a new interfering site from XML, or create a new one from scratch.

When adding many, all relevant sites in the database which you select are added. If you are adding sites from a TV database, all TV stations within distances as specified by the rules will be added to the scenario. When adding sites from a wireless database, all sites in the selected database will be added to the scenario.

Be sure to set your wireless frequency and wireless bandwidth as appropriate.

To run the study, Save and Close the study, and then click the Run button in the Study Manager window. A run window similar to that of the General-purpose mode will appear. For more information on how to use it, see page 42.

## Managing Studies

### *Duplicating a Study*

Much like duplicating a scenario, you can also duplicate an entire study.

To do so, select “Duplicate” from the Study dropdown menu. You are prompted to give the duplicated study a name, and then TVStudy immediately opens up the new duplicate study for you, on the assumption that you will immediately wish to make modifications.

When finished, simply close the Study window as usual and you will now be able to see both studies.

### *Refreshing the Study Manager*

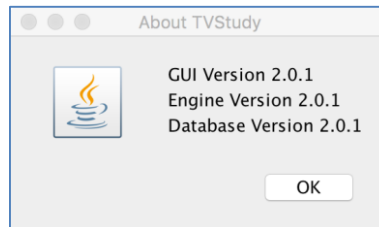
Because TVStudy is designed for use in a multi-user environment, it is possible for studies to be created by several users working simultaneously. However, these may not immediately automatically display in each user’s study manager. The list is refreshed automatically once per minute; to refresh the study manager immediately, select “Refresh List” from the Study dropdown menu.



## Using the TVStudy Help Menu

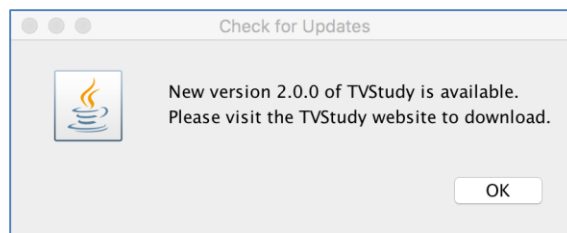
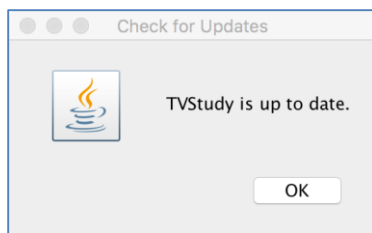
The TVStudy Help menu has four options, designed to help you use and maintain TVStudy.

### *About TVStudy*

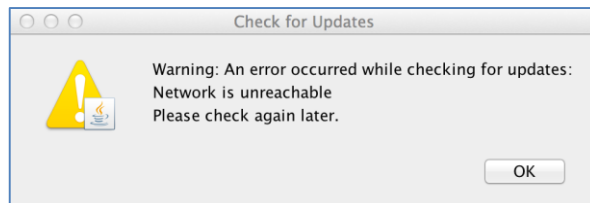
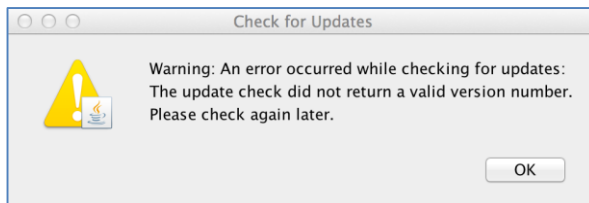


The About TVStudy menu option shows you the version number of the graphical user interface (GUI), the TVStudy engine, and the database. This may be helpful for troubleshooting issues if an upgrade from one version to another does not complete successfully.

### *Check for Updates*

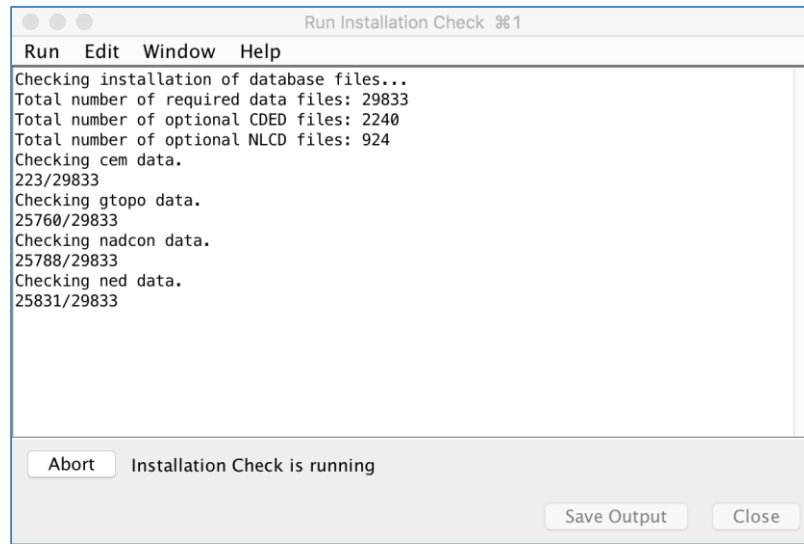


The Check for Updates menu option queries the TVStudy host server to determine if a newer version of TVStudy is available. Depending on the results of that query, one of the above messages will display.



If TVStudy is unable to reach the server for any reason while querying for a newer version, an error message like the ones above may display.

## Check Installation



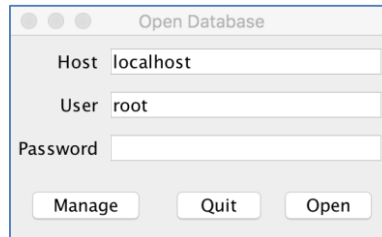
This option verifies all of the files in the dbase directory to ensure that none of the files are corrupt, missing, or inaccessible. It requires the Terrain Database Test and Verification Utility in order to function, which is available as a separate download on the TVStudy website. The utility must be placed in the directory /dbase.

## Documentation

The Documentation menu option will display this manual. Note that a copy of this manual must be located in the /help directory of TVStudy and be named "manual.pdf".

## Closing TVStudy

When closing TVStudy on the Mac, you must take care never to use the quit (⌘Q) command. This can leave the database in an unclean state, and any unsaved changes will be lost. Instead, you should always quit by using the red dot ( ● ) in the top-left corner of each window, until you are back at the “Open Database” window.



In the “Open Database” window, click “Quit.” The quit button will become active only when all of the other TVStudy windows are closed and it is safe to quit.

## Troubleshooting TVStudy

If you find you are unable to open a study, the study may be locked. A study is locked when it is being edited, either by you or another user, or when it is being used to run a study. If a study fails part way through, it may leave the database in an unclean state, including a state in which a lock may remain on the study in question even though that study is not in use. To resolve this, click on the study in question in the Study Manager window, and select “Unlock” from the Study dropdown menu.

It is uncommon, but not impossible to experience data corruption issues or similar unexplained events, and you may want to try remedying them by clearing the cache. TVStudy creates a large number of cache files in order to make multiple scenario runs in a study run faster, but if this cache becomes corrupt, unexpected behavior could occur. To clear the cache, click on the study in question in the Study Manager window, and select “Clear Cache” from the Study dropdown menu. Cache data files can also consume a large amount of disk space that can be recovered by clearing the cache on studies that are not actively being used. Once the cache is cleared, the calculations used to create the cached results will have to be repeated.

Should you encounter any lingering issues after conducting a pair study, you may consider clearing out unused records. The “Run Pair Study...” function creates multiple scenarios that are hidden from the user, but remain stored in cache after the run is finished. To clear such unused records, open the study in question, then select “Delete Unused Records” from the Scenario dropdown menu.

## Contact Information

If you encounter any problems and wish to speak with someone at the FCC about TVStudy, please e-mail Mark J. Colombo at the following address: [mark.colombo@fcc.gov](mailto:mark.colombo@fcc.gov)

## **APPENDIX A**

### **Study Parameters**

This appendix lists all of the study parameters available. It also notes which parameters can be set differently for **Each country** versus which apply to **All countries**, as well as which kinds of studies each is available for. (“**T**” means TV and wireless to TV, “**W**” means wireless to TV only, “**F**” means FM.)

#### *General*

<b>Grid type</b>	All countries	<b>T</b>			
Type of cell grid used to measure coverage area and population in the study.					
<ul style="list-style-type: none"> <li>• <b>Global</b> – Generates a uniform, global grid that all stations share.</li> <li>• <b>Local</b> – Generates grids unique to each station location. (Not permitted for OET-74.)</li> </ul>					
<b>Cell size</b>	All countries	<b>T</b>		<b>F</b>	
Nominal length of each side of a square grid cell, in kilometers.					
<b>Average terrain database</b>	All countries	<b>T</b>		<b>F</b>	
Terrain database used to calculate the height above average terrain of the transmitting antenna. TVStudy includes 30-second, 3-second, and 1-second terrain data. <sup>4</sup>					
<b>Average terrain profile resolution</b>	Each country	<b>T</b>		<b>F</b>	
Number of points per kilometer used to calculate the average terrain along each radial from a TV or FM station.					
<b>Path-loss terrain database</b>	All countries	<b>T</b>		<b>F</b>	
Terrain database used for Longley-Rice calculations. TVStudy includes 30-second, 3-second, and 1-second terrain data. <sup>4</sup>					
<b>Path-loss profile resolution</b>	Each country	<b>T</b>		<b>F</b>	
Number of points per kilometer used to determine the path profile for Longley-Rice path loss calculations from TV or FM stations.					
<b>U.S. population<sup>5</sup></b>		<b>T</b>		<b>F</b>	
Source of U.S. population data. Data is available from the U.S. Census for 2000 and 2010.					
<b>Canadian population<sup>5</sup></b>		<b>T</b>		<b>F</b>	
Source of Canadian population data. Data is available from the Canadian Census for 2006 and 2011.					
<b>Mexican population<sup>5</sup></b>		<b>T</b>		<b>F</b>	
Source of Mexican population data. Data is available from the 2010 Mexican Census.					
<b>Round population coordinates</b>	Each country	<b>T</b>			
The FCC’s Media Bureau tv_process application processing software rounds Census Block coordinates to the nearest integer second. If checked, TVStudy will round population coordinates in the same way.					

<sup>4</sup> The search order for terrain databases is usually CDED, CEM, NED, USGS, SRTM, then GTOPO. This search order applies if data is missing from the preferred terrain database, beginning with the preferred database for the selected terrain database. This means that if 3-second terrain is selected, it will search other 3-second terrain databases, then the 30-second GTOPO terrain database, but not the 1-second terrain databases.

<sup>5</sup> Selecting “None” will disable population counting for that country and TVStudy will not report land area separately for that country; total land area will instead be reported.

***Distances***

<b>Check individual DTS transmitter distances</b>	All countries	<b>T</b>			
When checked, this option uses the culling distance with regard to each DTS transmitter site to determine potential interference cells or stations, rather than only using the reference coordinates. When unchecked, only the reference coordinates are used to determine potential interference cells or stations.					
<b>Co-channel MX distance</b>	All countries	<b>T</b>		<b>F</b>	
This constant determines when two stations are considered to be mutually exclusive (MX) for the purposes of creating a scenario. Setting this value to zero disables this check; however, other checks for mutual exclusivity may still be applied, such as when the city, state, country, and channel are all the same between two records.					
<b>Rule limit extra distances (and break points)</b>	All countries	<b>T</b>		<b>F</b>	
These constants control the distance in kilometers beyond the distance specified in OET Bulletin No. 69 that a distance-based query will search for interferers for stations. Adding extra distance can help ensure that all possible interferers are considered. For stations which are not full-power UHF, the ERP will be normalized to the full-power UHF value before applying the distances here, and the break points are in kilometers and adjustable as well.					
<b>Spherical earth distance</b>	All countries	<b>T</b>		<b>F</b>	
This constant specifies the spherical earth distance in kilometers per degree of arc. This constant is used for distance and bearing calculations as well as calculating depression angles in True Geometry mode.					

***CDBS/LMS***

<b>Respect CDBS DA flag</b>	All countries	<b>T</b>		<b>F</b>	
In CDBS/LMS, there are a number of stations which have an antenna pattern ID specified, but are flagged as “non-directional.” The default behavior of TVStudy is to ignore the flag and use the antenna pattern specified, if present. Checking this box means that the flag will always be respected (potentially ignoring directional antenna pattern data when present).					
<b>HAAT radial count</b>	Each country	<b>T</b>		<b>F</b>	
Defines the number of radials used to compute HAAT for TV and FM stations.					
<b>Mexican ERP and HAAT values</b>		<b>T</b>		<b>F</b>	
In CDBS/LMS, there are a number of Mexican allotments that lack ERP and HAAT values. These settings control what ERP and HAAT values are assigned to those allotments.					
<b>[First/Last] TV channel</b>	All countries	<b>T</b>			
Sets the lower/upper channel limit used for importing data from CDBS/LMS.					

### Patterns

(These parameters only apply to TVStudy's handling of TV or FM antenna patterns.)

<b>Depression angle method</b>	Each country	<b>T</b>		<b>F</b>	
Controls how depression angles are calculated. <ul style="list-style-type: none"> <li>• <b>Effective height</b> – This method approximates the depression angle using height above ground level, mirroring the behavior of tv_process.</li> <li>• <b>True geometry</b> – This method calculates the actual depression angle using curved-Earth geometry and heights above mean sea level.</li> </ul>					
<b>Use mechanical beam tilt</b>	Each country	<b>T</b>		<b>F</b>	
<ul style="list-style-type: none"> <li>• <b>Never</b> – Never apply mechanical beam tilt values.</li> <li>• <b>Always</b> – The mechanical beam tilt values specified in CDBS/LMS will always be applied to the antenna elevation pattern.</li> <li>• <b>Real patterns only</b> – The mechanical beam tilt values specified in CDBS/LMS will only be applied to stations for which real elevation patterns are provided (either from CDBS/LMS or user-entered).</li> </ul>					
<b>Use generic patterns by default</b>	Each country	<b>T</b>		<b>F</b>	
If checked, the generic OET69 elevation pattern will be applied. If unchecked, a non-directional elevation pattern will be used.					
<b>Mirror generic patterns</b>	Each country	<b>T</b>		<b>F</b>	
The generic OET Bulletin No. 69 elevation pattern does not specify field values for depression angles less than 0.75° and so a value of 1.0 is assumed above that depression angle. Checking this box creates a symmetric elevation pattern with a maximum field value of 1.0 at 0.75° (or some other depression angle, depending upon the other parameter settings).					
<b>Beam tilt on generic patterns</b>	Each country	<b>T</b>		<b>F</b>	
These options control how beam tilt is applied to the generic OET Bulletin 69 elevation pattern. <ul style="list-style-type: none"> <li>• <b>None</b> – Assumes a 0.75° beam tilt for all stations.</li> <li>• <b>Full</b> – Adds the values in CDBS to a 0.75° beam tilt for all stations.</li> <li>• <b>Offset</b> – Subtracts 0.75° from the generic pattern, then adds the value in CDBS/LMS. This setting results in maximum radiation in the elevation plane being at the depression angle specified in CDBS for that station.</li> </ul>					
<b>Double generic pattern values</b>	Each country	<b>T</b>			
These options control when the generic OET Bulletin No. 69 elevation pattern field values are doubled when used with LPTV and Class A TV stations. <ul style="list-style-type: none"> <li>• <b>Never</b> – The values are never doubled for any station(s).</li> <li>• <b>LPTV only</b> – The values are doubled for LPTV stations but not for Class A stations.</li> <li>• <b>LPTV and Class A</b> – The values are doubled for both LPTV stations and Class A stations.</li> </ul>					
<b>Invert negative tilts</b>	Each country	<b>T</b>		<b>F</b>	
Although beam tilts are conventionally angles of depression ( <i>i.e.</i> , below the horizontal, so that a value of 90 means straight down and -90 means straight up), and radiation above the horizon is required to be minimized under FCC rules, some CDBS/LMS records give negative values for beam tilt. If checked, any negative electrical beam tilt values in CDBS/LMS will be assumed to be positive and thus ensures that maximum radiation is always at or below the horizontal.					
<b>[Digital/Analog/FM] receive antenna f/b</b>	All countries	<b>T</b>		<b>F</b>	
These fields control the front to back ratio (in decibels referenced to a dipole (dBd)) of the receive antenna used for digital TV, analog TV, and FM stations.					

**Contours**

<b>Use elevation patterns</b>	Each country	<b>T</b>		<b>F</b>	
Controls how elevation patterns are used to project contours. <ul style="list-style-type: none"> <li>• <b>Never</b> – The elevation pattern is never used to project contours.</li> <li>• <b>Full-service TV only</b> – The elevation pattern is only used to project contours for full-service TV stations.</li> <li>• <b>All stations</b> – The elevation pattern is always used to project contours for every station regardless of class.</li> </ul>					
<b>Use real elevation patterns</b>	Each country	<b>T</b>		<b>F</b>	
Allows the use of actual antenna elevation patterns for contour projection for all stations. If not selected, generic patterns are always used, or no elevation pattern is used if the “Use generic patterns by default” parameter is also unchecked, even if actual elevation pattern is available.					
<b>Propagation curve set, [digital/analog/FM]</b>	Each country	<b>T</b>		<b>F</b>	
Controls which F-curve set is used to calculate the contour for digital TV/analog TV/FM stations.					
<b>Lookup method below curve minimum distance</b>	All countries	<b>T</b>		<b>F</b>	
In certain cases, station power may be so low that there is no contour distance available from which to project the contour. In these cases, you can choose TVStudy’s behavior. <ul style="list-style-type: none"> <li>• <b>Free-space</b> – When no curves data is available, use free-space calculations.</li> <li>• <b>Scaled free-space</b> – When no curves data is available, use free-space calculations but scale them to prevent discontinuities with the curves data.</li> <li>• <b>None</b> – When no curves data is available, use the value of the last available curves data point.</li> </ul>					
<b>[Digital/Analog] TV full-service contour</b>	Each country	<b>T</b>			
Controls the relevant thresholds (for each band) used to project the TV service contours.					
<b>[Digital/Analog] Class A/LPTV contour</b>	Each country	<b>T</b>			
Controls the relevant thresholds (for each band) used to project the LPTV and Class A TV service contours.					
<b>Use UHF dipole adjustment</b>	Each country	<b>T</b>			
Controls whether or not a “dipole adjustment” is applied to the service threshold at UHF.					
<b>Dipole center frequency</b>	Each country	<b>T</b>			
Sets the center frequency for the UHF dipole adjustment.					
<b>FM full-service [(all)/class B/class B1] contour</b>	Each country			<b>F</b>	
Controls the relevant thresholds used to project the service contours.					
<b>[FM NCE/LPFM/FM translator] contour</b>	Each country			<b>F</b>	
Controls the relevant thresholds used to project the service contours.					
<b>Contour radial count</b>	Each country	<b>T</b>		<b>F</b>	
Number of radials used to project the contour. If different from Contour HAAT radial count, HAAT values are interpolated between lookup values.					
<b>Contour HAAT radial count</b>	Each country	<b>T</b>		<b>F</b>	
Number of radials to use for HAAT lookup during contour projection.					
<b>Minimum HAAT</b>	Each country	<b>T</b>		<b>F</b>	
Minimum height above average terrain used to project contours.					
<b>Average terrain [start/end] distance</b>	Each country	<b>T</b>		<b>F</b>	
Distance where terrain samples begin/end for calculation of HAAT and projection of contours.					
<b>Truncate DTS service area</b>	All countries	<b>T</b>			
If checked, TVStudy limits the coverage areas of DTS stations to the DTS distance limits.					

<b>DTS distance limit</b>	All countries	<b>T</b>			
By default, these are the DTS coverage limits specified in the Table of Distances <sup>6</sup> . These values are used only if Truncate DTS service area is checked and no value is provided by CDBS or in the station record.					
<b>Service distance limit</b>	Each country	<b>T</b>			
These options restrict the Longley-Rice prediction area to within these distances.					

### ***TV Replication***

<b>Replication method</b>	Each country	<b>T</b>			
Controls how replication of stations onto different channels is performed. <ul style="list-style-type: none"> <li>• <b>Derive Pattern</b> – Adjusts the ERP and antenna pattern to closely match the original contour. This usually results in a change to the azimuth pattern of the station.</li> <li>• <b>Equal Area</b> – Adjusts the ERP to match the geographic area enclosed by the original contour. This setting maintains the original azimuth pattern but may slightly change the contour distances.</li> </ul>					
<b>Digital full-service [minimum/maximum] ERP</b>	Each country	<b>T</b>			
These values set the minimum/maximum ERP used in replication of full-service stations on each TV band.					
<b>Digital Class A/LPTV [minimum/maximum] ERP</b>	Each country	<b>T</b>			
These values set the minimum/maximum ERP used in replication of Class A and LPTV stations on each TV band.					

<sup>6</sup> See 47CFR §73.626(c).



***Pathloss<sup>7</sup>***

<b>Longley-Rice error handling</b>	Each country	<b>T</b>		<b>F</b>	
Controls how TVStudy handles the Longley-Rice warning flags. Note that warnings can be triggered either by a desired station or an undesired station, and is specific to a given signal path. <ul style="list-style-type: none"> <li>• <b>Disregard</b> – Accepts the path loss result from Longley-Rice. (Always applied to the desired TV signal for D/U calculations involving wireless interferers.)</li> <li>• <b>Assume service</b> – Assumes service for warnings on desired signal paths and no interference for warnings on undesired signal paths.</li> <li>• <b>Assume interference</b> – Assumes no service for warnings on desired signal paths and interference for warnings on undesired signal paths.</li> </ul>					
<b>Cap D/U ramp function</b>	All countries	<b>T</b>			
Allows a cap to be placed on the value of the D/U ramp function.					
<b>Ramp function cap</b>	All countries	<b>T</b>			
If enabled by the above parameter setting, the cap on the D/U ramp function in dB.					
<b>Adjust FM D/U for IBOC</b>	All countries			<b>F</b>	
When checked, applies a formula derived from the formula defined in DA 10-208 to calculate IBOC interference to adjacent-channel FM stations. When unchecked, the presence of IBOC interference is ignored.					
<b>Receiver height AGL</b>	All countries	<b>T</b>		<b>F</b>	
Receive antenna height above ground, in meters.					
<b>Minimum transmitter height AGL</b>	All countries	<b>T</b>		<b>F</b>	
Minimum transmit antenna height above ground, in meters.					
<b>[Digital/Analog] desired % location</b>	All countries	<b>T</b>		<b>F</b>	
Longley-Rice statistical parameter specifying the percentage of locations expected to get service.					
<b>[Digital/Analog] desired % time</b>	All countries	<b>T</b>		<b>F</b>	
Longley-Rice statistical parameter specifying the percentage of time service is expected.					
<b>[Digital/Analog] desired % confidence</b>	All countries	<b>T</b>		<b>F</b>	
Longley-Rice statistical parameter specifying the confidence (situational variability) that service is expected.					
<b>[Digital/Analog] undesired % location</b>	All countries	<b>T</b>		<b>F</b>	
Longley-Rice statistical parameter specifying the percentage of locations expected to get interference.					
<b>[Digital/Analog] undesired % confidence</b>	All countries	<b>T</b>		<b>F</b>	
Longley-Rice statistical parameter specifying the confidence (situational variability) interference is expected.					
<b>Signal polarization</b>	All countries	<b>T</b>		<b>F</b>	
Polarization of transmitted signal.					
<b>Atmospheric refractivity</b>	All countries	<b>T</b>		<b>F</b>	
Refractivity referenced to mean sea level, in N-units.					
<b>Ground permittivity</b>	All countries	<b>T</b>		<b>F</b>	
Relative ground permittivity.					
<b>Ground conductivity</b>	All countries	<b>T</b>		<b>F</b>	
Ground conductivity in Siemens per meter.					

<sup>7</sup> See NTIA Report 82-100, April 1982 for further explanation of the Longley Rice model path loss parameters.

<b>Longley-Rice service mode</b>	All countries	<b>T</b>		<b>F</b>	
Longley-Rice model parameter.					
<b>Longley-Rice climate type</b>	All countries	<b>T</b>		<b>F</b>	
Climactic zone.					

*Service*

<b>Set service thresholds</b>	All countries	<b>T</b>		<b>F</b>	
If checked, these thresholds are used for Longley-Rice calculations in lieu of the thresholds used for contour calculations. If unchecked, the same thresholds are used for Longley-Rice calculations as are used for contour calculations.					
<b>Digital full-service threshold</b>	Each country	<b>T</b>		<b>F</b>	
Controls the relevant thresholds (for each band) used to project the noise-limited service contours.					
<b>Digital Class A/LPTV threshold</b>	Each country	<b>T</b>		<b>F</b>	
Controls the relevant thresholds (for each TV band) used to project the protected service contours.					
<b>Analog full-service threshold</b>	Each country	<b>T</b>		<b>F</b>	
Controls the relevant thresholds (for each TV band) used to project the service contours.					
<b>Analog Class A/LPTV threshold</b>	Each country	<b>T</b>		<b>F</b>	
Controls the relevant thresholds (for each TV band) used to project the protected service contours.					
<b>Use UHF dipole adjustment</b>	Each country	<b>T</b>			
Controls whether or not a “dipole adjustment” is applied to the service threshold at UHF.					
<b>Dipole center frequency</b>	Each country	<b>T</b>			
Sets the center frequency for the UHF dipole adjustment.					
<b>FM full-service [(all)/class B/class B1] threshold</b>	Each country			<b>F</b>	
Controls the relevant thresholds used to project the service contours.					
<b>[FM NCE/LPFM/FM translator] threshold</b>	Each country			<b>F</b>	
Controls the relevant thresholds used to project the service contours.					

*Clutter*

<b>Apply clutter adjustments</b>	All countries	<b>T</b>		<b>F</b>	
If checked, clutter adjustments are applied as specified in OET Bulletin No. 73.					
<b>[Category, band]</b>	Each country	<b>T</b>		<b>F</b>	
Controls the clutter adjustment factor for each band in each of ten categories specified in OET Bulletin No. 73.					
<b>[Category mapping]</b>	All countries	<b>T</b>		<b>F</b>	
Allows users to modify the mapping between the sixteen land cover categories in the NLCD database and the ten clutter categories specified in OET Bulletin No. 73.					

**Wireless**

<b>Required D/U</b>	Each overlap	<b>W</b>			
Controls the D/U threshold applied based on wireless to TV channel spectral overlap value.					
<b>Culling Distances</b>	Each overlap	<b>W</b>			
Controls the culling distance from the protected TV contour based on spectral overlap, wireless site HAAT, and wireless site ERP					
<b>Cap alpha factor</b>	All overlaps	<b>W</b>			
Allows a cap to be placed on the value of the $\alpha$ factor.					
<b>Alpha factor cap</b>	All overlaps	<b>W</b>			
If enabled by the above parameter setting, the cap on the $\alpha$ factor in dB.					
<b>Average terrain profile resolution</b>	All overlaps	<b>W</b>			
Number of points per kilometer used to calculate the average terrain along each radial from the wireless station.					
<b>Path-loss profile resolution</b>	All overlaps	<b>W</b>			
Number of points per kilometer used to calculate the path profile along each radial from the wireless station.					
<b>HAAT radial count</b>	All overlaps	<b>W</b>			
Number of radials used to determine the HAAT of the wireless station.					
<b>Depression angle method</b>	All overlaps	<b>W</b>			
Controls how depression angles are calculated. <ul style="list-style-type: none"> <li>• <b>Effective height</b> – This method approximates the depression angle using height above ground level, mirroring the behavior of tv_process.</li> <li>• <b>True geometry</b> – This method calculates the actual depression angle using curved-Earth geometry and heights above mean sea level.</li> </ul>					
<b>Use mechanical beam tilt</b>	All overlaps	<b>W</b>			
If selected, TVStudy will use mechanical tilt as specified in the wireless antenna dataset.					
<b>Mirror generic patterns</b>	All overlaps	<b>W</b>			
If a wireless site uses the OET-69 generic elevation pattern this option allows for the mirroring of the pattern above and below the maximum relative field strength value.					
<b>Minimum transmitter height AGL</b>	All overlaps	<b>W</b>			
Specifies the minimum wireless transmitter height above ground level. If TVStudy finds the site is below this level based on the RCAMSL value provide it will adjust the transmitter height.					
<b>Undesired % location</b>	All overlaps	<b>W</b>			
Longley-Rice statistical parameter of location probability for wireless station path loss.					
<b>Undesired % time</b>	All overlaps	<b>W</b>			
Longley-Rice statistical parameter of time probability for wireless station path loss.					
<b>Undesired % confidence</b>	All overlaps	<b>W</b>			
Longley-Rice statistical parameter of confidence probability for wireless station path loss.					
<b>Signal polarization</b>	All overlaps	<b>W</b>			
Polarization of wireless transmitted signal.					
<b>Longley-Rice service mode</b>	All overlaps	<b>W</b>			
Longley-Rice model parameter.					

## **APPENDIX B**

### **Files Required to Import a Dataset**

#### ***FCC Datasets***

The following files are required for TVStudy to successfully import a CDBS TV dataset:

- |                               |                              |
|-------------------------------|------------------------------|
| • am_ant_sys.dat              | • elevation_ant_make.dat     |
| • ant_make.dat                | • elevation_pattern.dat      |
| • ant_pattern.dat             | • elevation_pattern_addl.dat |
| • application.dat             | • facility.dat               |
| • app_tracking.dat            | • tv_app_indicators.dat      |
| • dtv_channel_assignments.dat | • tv_eng_data.dat            |

The following files are required for TVStudy to successfully import a CDBS FM dataset:

- |                          |                              |
|--------------------------|------------------------------|
| • ant_make.dat           | • elevation_pattern_addl.dat |
| • ant_pattern.dat        | • facility.dat               |
| • application.dat        | • fm_eng_data.dat            |
| • app_tracking.dat       | • fm_app_indicators.dat      |
| • elevation_ant_make.dat | • if_notification.dat        |
| • elevation_pattern.dat  |                              |

The structure of the CDBS data files is laid out in /lib/cdbbs\_table\_defs.dat such that future changes to the table structure can be implemented simply by modifying or replacing that file.

The following files are required for TVStudy to successfully import an LMS TV dataset:

- |                                     |                               |
|-------------------------------------|-------------------------------|
| • application.dat                   | • app_antenna_field_value.dat |
| • application_facility.dat          | • app_antenna_frequency.dat   |
| • app_antenna.dat                   | • app_location.dat            |
| • app_antenna_elevation_pattern.dat | • license_filing_version.dat  |

LMS datasets do not currently support checks with relation to AM towers due to the absence of AM data within LMS.

LMS datasets are currently not supported for FM due to the absence of FM data within LMS.

## Wireless Datasets

The two user created files are required to create a wireless dataset.

File 1: <basestation\_data>.csv. This is a comma separated file with up to seventeen (17) fields and a new row for each wireless base station/sector. This file should not have a header row.

	Field name	Type	Description
1	Cell Site ID	Char(12)	This must not be blank and cannot contain ' ', ',' or new line characters.
2	Sector ID	Integer	This field is concatenated with the Cell Site ID to form the wireless "callsign" in TVStudy GUI and reports. This field may be blank. This field cannot contain ' ', ',' or new line characters.
3	Latitude (degrees)	Float	This field is NAD 83 with positive decimal degrees indicating Northern hemisphere. This field must contain a value in the range -75 to +75 degrees.
4	Longitude (degrees)	Float	This field is NAD 83 with negative decimal degrees indicating Western hemisphere. This field must contain a value in the range -180 to +180 degrees.
5	Ant Height(m)	Float	This is the base station transmit antenna radiation center height above mean sea level (AMSL) in meters.
6	HAAT (m)	Float	This is the base station transmit antenna radiation center height above average terrain (HAAT) in meters. This must be a value between -1000 and +10,000 meters. The value -999 will cause HAAT to be calculated by TVStudy.
7	ERP (kW)	Float	This is the base station effective radiated power in kilo-watts. This field must contain a value between 0.00001 and 5,000.
8	Az AntID	Integer	This is a pointer to the azimuth pattern in the associated wireless antenna database. 0 or blank means omni-directional antenna, otherwise this number must be greater than zero. If a pattern data for an ID does not exist an omni-directional pattern will be applied during the study.
9	Orientation (degrees true N)	Float	0 means true north. If blank the default is 0, otherwise the value must be in the range -360 to +360 degrees.
10	El AntID	Integer	This is a pointer to the elevation pattern in the associated wireless antenna database. 0 or blank means omni-directional antenna, otherwise this field must be greater than zero.
11	ETilt (degrees)	Float	Electrical tilt where positive degrees is downward tilt. If blank the default is 0, otherwise the value must be in the range -10 to +11.1 degrees.
12	MTilt (degrees)	Float	Mechanical tilt where positive degrees is downward tilt. If blank the default is 0, otherwise the value must be in the range -10 to 11.1 degrees.

13	MTilt Orientation (degrees)	Float	0 means true north. If this is blank or not present the default is the azimuth pattern orientation, otherwise the value must be in the range -360 to +360 degrees.
14	Reference Data	Char(22)	Optional field. This field is available for short notes about site.
15	City	Char(20)	Optional field. City associated with wireless site.
16	State	Char(2)	Optional field.
17	Country	Char(2)	"US", "CA", or "MX". When missing it is assumed to be "US".

File 2: <baseantenna\_data>.csv. This is a comma separated file with a new row for each antenna pattern and five (5) or more fields as follows. This file does not have a header row.

	Field name	Type	Description
1	AntID	Integer	This must be a value greater than zero (0). This field should tie back to either the AAntID or EAntID field in the wireless base station file.
2	Pattern Type	Char(1)	"A" or "a" for azimuth pattern or "E" or "e" for elevation pattern
3	Pattern Name	Char(255)	Must not be blank and must not contain ' ', ',', or new line characters.
4 until end of line	Pattern points	Float;float	Each comma-delimited field contains a degree value and a relative field value separated by a semicolon, for example "0;1.0,10;0.95,20;0.89,...". There must be at least two points in a pattern. For an azimuth pattern, the degree values must be in the range 0 to 359.999. For an elevation pattern, the degree range is -90 to 90. In either case the degree values must appear in order with no duplication. Relative field values must be greater than 0 and less than or equal to 1. If a pattern does not contain at least one point with relative field of 1 a warning message will be generated, however, import will continue.

## **APPENDIX C**

### **Output File Data**

To make the various output files smaller and easier for a computer to use, a number of numerical codes are used to replace words in the output. A key for translating these, as well as a list of definitions of certain other terms used within the Appendices, is provided below. In all following appendices, spaces after commas are included for legibility and are not found in the output files.

#### ***Study Key***

This is a unique identifier for a given study.

#### ***Fac (Facility) ID***

The Facility ID is a unique integer in CDBS/LMS used to identify a station.

#### ***File Number***

This is a number denoting a specific filing in CDBS/LMS. For applications filed in CDBS, it consists of a prefix to indicate the type of filing, and an Application Reference Number (ARN) to make it unique. LMS-filed applications only have the ARN.

#### ***Country Key***

**1** = United States

**2** = Canada

**3** = Mexico

Country keys can appear in the results for two purposes. They can either refer the country from which the station being evaluated originates, or to the country in which the evaluation point is located.

#### ***Country Code***

**US** = United States

**CA** = Canada

**MX** = Mexico

Country codes are used in XML files and in some of the summary reports.

#### ***Service Type***

**1** = Digital TV Full Service (CDBS: DT, DD, DS, DX, DR, DM, DN)

**2** = Analog TV Full Service (CDBS: TV, TS, TA, TR, NM, NN)

**3** = Digital TV Class A (CDBS: DC)

**4** = Analog TV Class A (CDBS: CA)

**5** = Digital LPTV or Translator (CDBS: LD)

**6** = Analog LPTV or Translator (CDBS: TX, TB)

**11** = Wireless sites (WL)

**21** = FM Full Service (CDBS: FM, FS, FA, FR)

**22** = FM Low Power (CDBS: FL)

**23** = FM Translator or Booster (CDBS: FX, FB)

#### ***Source Key***

This is a unique identifier for a given station facility within a scenario. This is a temporary key assigned within each study and thus will change for the same station from study to study.

***DTS Key***

This is a key for DTS record sets. A DTS station has multiple records, always listed together in the file. The first is a record called the parent. The Source Key from the parent record appears in the DTS Key field for all related records. On the actual parent record, the Source Key is the same as the DTS Key. The parent always has Site value of **0**. Among the other records with the same DTS Key but other Source Key values, one of those will also have Site value of **0**, and that is the reference facility record. That record may have different file number, application ID, and channel than the parent; it provides a bounding contour only. Other records with the same DTS Key and Sites other than 0 are the actual DTS transmitter sources. Those all have the same identifying information and channel shown on the parent record, so that information is not repeated.

***Site***

Site number. For DTS records it is used to identify the different records in a group for a DTS operation. See “DTS Key” discussion.

***App (Application) ID***

CDBS Application ID number, if available.

***Des (Desired) Flag***

**0** = Station was not studied as desired; its coverage was not evaluated

**1** = Station was studied as desired; its coverage was evaluated

***Und (Undesired) Flag***

**0** = Station was not studied as undesired; it could not cause interference to desired stations

**1** = Station was studied as undesired; it may contribute interference to desired stations

***From Channel***

When the station service is being replicated on a different channel from its original channel, this column shows the original channel.

***DTS Distance***

For a DTS parent record, this is the distance limit around the reference point. This may be from the distance table in FCC Rules section 73.626(c), or it may be a custom value from the CDBS record.

***DA (Directional Antenna)***

Flag that specifies whether or not an antenna is directional in the azimuth direction.

**DA** = Directional Antenna

**ND** = Non-Directional Antenna

***Ant (Antenna) ID***

CDBS Antenna ID number, if available.

***Rotation***

Degrees of clockwise azimuth rotation applied to the antenna pattern.



**Offset**

**0** = N/A  
**2** = Plus

**1** = Zero  
**3** = Minus

**Mask Filter**

**0** = N/A (Analog) or Full-Service (Digital)  
**2** = Stringent

**1** = Simple  
**3** = Full-Service

**Mask Type**

**S** = Simple

**T** = Stringent

**F** = Full-service

**Grid Type**

**1** = Local

**2** = Global

**Cell Latitude Size**

This is the size of each cell in seconds with regard to latitude, since it is uniform across the grid.

**Lat Index, Lon Index**

Index keys for a study grid cell, given as the coordinates of the cell's southeast corner in integer arc-seconds. These are for identification and relative location only; actual coverage calculations occur at discrete points within each cell, one point for each country with population in the cell.

**Field Count**

Indicates how many transmitters are in a DTS (Distributed Transmission System) network. The reference point is not included in this count. If the facility is not a DTS, value is **1**.

**Clutter**

Indicates what clutter correction was applied to the cell. If **0**, clutter was not enabled. Otherwise, the clutter category (**1-10**) is indicated. The clutter categories are listed in OET Bulletin No. 73, Table 3.

**Result Code**

**1** = Interference-free service      **2** = Interference      **3** = No service  
**11** = Interference-free service, but encountered a Longley-Rice warning  
**12** = Interference, but encountered a Longley-Rice warning  
**13** = No service, but encountered a Longley-Rice warning

**Causes Ix (Interference)**

**0** = Does not cause interference

**1** = Causes interference

**Point Key**

Single integer index key for a study grid cell, primarily used in pair studies. This value is only valid for north latitude and west longitude, and will otherwise be -1.

**Service Flag**

**0** = Does not have service      **1** = Has service

**KWX Flag**

**0** = Does not have a Longley-Rice warning flag      **#** = Has a Longley-Rice warning flag (1-4)

**Status**

**APP** = Application filed

**CP MOD** = Modification to CP granted

**LIC** = Licensed facility

**CP** = Construction Permit granted

**GRANT** = Allotment Granted

**STA** = Special Temporary Authority

**Channel Description**

In the tvstudy.txt file, station channel numbers are listed in a four part coding scheme as M#CO, where:

- "M" is either "N" or "D" for Analog or Digital, respectively,
- "#" is the channel number,
- "C" is the station class and will be "A" for Class A or "L" for LPTV stations (Full-power stations will not have a value), and
- "O" is the channel offset (for analog stations only) and will be "-", "z", or "+".

**Key**

**LatIndex-LonIndex-CountryKey** = This field is comprised of hyphen separated values of integer seconds for the grid cell south east corner and the country key for the grid cell.

**Root Sum Square**

This is the square root of the power summation of all the wireless received field strength after receiver antenna discrimination in a single grid cell.

$$RSS = 20 * \log_{10} \left( \sum \left( 10^{\left( \frac{dB\mu + Gr}{20} \right)^2} \right)^{\frac{1}{2}} \right) = 10 * \log_{10} \left( \sum 10^{\left( \frac{dB\mu + Gr}{10} \right)} \right)$$

**SNR Factor**

This is the same value as the provided by the D/U ramp function and is defined as alpha ( $\alpha$ ) in OET Bulletin No. 74.

## **APPENDIX D**

### **Formats of the CSV Output Files**

#### ***Format of the Summary CSV File***

The file is labeled “tvstudy.csv” and appears within the `out/<servername>/<study>` directory. It can contain data from multiple scenarios.

```
TVStudy Version Number, Database Server, Study Key
Scenario Name, Comment
Fac ID, File Number, Country Key for Area/Pop, Service Type, Channel, Country Key
    for Area/Pop, Noise Lim Area, Noise Lim Pop, Terr Lim Area, Terr Lim Pop, Ix Lim
    Area, Ix Lim Pop
```

#### ***Format of the Parameters Output File***

The file is labeled “parameters.csv” and appears within the `out/<servername>/<study>/<scenario>` directory. It contains all of the parameters used in the computation of coverage and interference for all the stations in the scenario.

```
TVStudy Version Number
Database Server
CDBS Used
Study Name
Fac ID, Source Key, DTS Key, Site, File Number, App ID, Country Key for Station, Des
    Flag, Und Flag, Channel, From Channel, City, State, Lat, Lon, DTS Distance,
    RCAMSL, HAAT, ERP, DA, Ant ID, Rotation, E Beam Tilt, Offset, Mask Filter,
    Service Type, Country Key for Area/Pop, Noise Lim Area, Noise Lim Pop, Terr Lim
    Area, Terr Lim Pop, Ix Lim Area, Ix Lim Pop,, Antenna Information,, [Extra
    Azimuth, Extra Field Value, ...]
```

The Antenna Information section gives the field value for each 10-degree increment of azimuth. If any other important field values exist at other azimuths, they are given as Extra Field Values, which show the Azimuth followed by the Field Value, repeating until all have been provided.

**Format of the Points Output File**

The file is labeled “points.csv” and appears within the `out/<servername>/<study>/<scenario>` directory. It contains all of the cells used in a single scenario.

**Global grid mode:**

Lat Index, Lon Index, Country Key for Point, Point Key, Point Lat, Point Lon, Point Elevation, Point Area, Point Pop, Clutter

**Local grid mode:**

SourceKey, Lat Index, Lon Index, Country Key for Point, Point Lat, Point Lon, Point Elevation, Point Area, Point Pop, Clutter

In the global mode, the Point Key is undefined for cell sizes less than 0.5 km and for grid cells outside of the northern and western hemispheres. The Point Key algorithm was designed to produce a 32-bit integer single key to help reduce storage size for SQL tables containing pair study output data. At cell sizes less than 0.5 km the number of bits required to enumerate all cells may exceed the 32-bit integer range, so the Point Key cannot be defined.

## **APPENDIX E**

### **Formats of the Cell Output Files**

#### ***Format of the Summary Cell Output File***

The file is labeled “tvstudy.cel” and appears within the `out/<servername>/<study>` directory. It contains summary data for all scenarios that were selected to run.

#### **Global Grid Mode**

```
[scenario]
Database Server
Study Name
Scenario Name
Timestamp
Cell Size, Grid Type, Cell Latitude Size
[comment]
Comment
[endcomment]
[sources]
Source Key, Des Flag, Und Flag, Country Key for Station, Service Type, Channel, Fac
      ID, File Number
[endsources]
[grid]
Lat Index South Limit, Lon Index East Limit, Lat Index North Limit, Lon Index West
      Limit
[cell]
Lat Index, Lon Index
P, Country Key for Point, Point Area, Point Pop, Clutter
R, Source Key, Result Code
[endcell]
[endgrid]
[endscenario]
```

Each cell can have multiple “P” (point) entries, one for each country that has a study point in the cell. Each “P” line may be followed by multiple “R” (result) entries, one for each station that provides service at that point. **Note:** A cell file may contain study grids that overlap. Thus, there may be multiple [grid] blocks that overlap, some containing data for the same desired stations. See detailed notes below.

#### **Local Grid Mode**

The local grid mode has the same format, except the [cell]/[endcell] blocks will be replaced with:

```
[source]
Source key
R, Country Key for Point, Lat Index, Lon Index, Point Area, Point Pop, Clutter
[endsource]
```

Each source block contains “R” lines for all study points considered for one station only. Each desired station will have a separate source block.

### ***Format of the Detailed Cell Output File***

The file is labeled “tvstudy.cel” and appears within the `out/<servername>/<study>/<scenario>` directory. It contains data from only one scenario.

#### **Global Grid Mode**

```
[scenario]
Database Server
Database Used
Study Name
Scenario Name
Timestamp
Cell Size, Grid Type, Cell Latitude Size
[comment]
Comment
[endcomment]
[sources]
Source Key, Des Flag, Und Flag, Country Key for Station, Service Type, Channel,
    Service Level, Field Count, Fac ID, Lat Index South Limit, Lon Index East Limit,
    Lat Index North Limit, Lon Index West Limit, File Number, Call Sign
[endsources]
[grid]
Lat Index South Limit, Lon Index East Limit, Lat Index North Limit, Lon Index West
    Limit
[cell]
Lat Index, Lon Index
P, Country Key for Point, Point Lat, Point Lon, Point Area, Point Pop, Clutter
D, Source Key, Field Strength, Bearing, KWX Flag, Service Flag
U, Source Key, Field Strength, Bearing, Receive Pattern Adjustment, KWX Flag, Causes
    Ix
DU, D/U Ratio, Rule Value for Comparison, D/U Ramp Function Adjustment
[endcell]
[endgrid]
[endscenario]
```

Each cell can have multiple “P” (point) entries, one for each country with a study point in the cell. Each “P” line is followed by one or more “D” (desired) entries, one for each desired station whose contour covers the population centroid point described by the “P” line. Similarly, each “D” line can have multiple “U” (undesired) and “DU” (D/U ratio) lines, for each undesired station that is within the culling distance of the desired station as specified by the study rules. However, there is not a guarantee that “U” records always follow a “D”, nor that a “DU” record will always follow a “U”, since Longley-Rice warnings may abort the analysis for that grid cell if TVStudy is set to “Assume Service” or “Assume Interference” and the subsequent records will not be generated.

In the [sources] section, undesired stations do not have Lat Index Limit values.

Please note that a tvstudy.cel file may contain study grids that overlap. Thus, there may be multiple overlapping [grid] blocks, each containing data for the same desired stations. See the detailed notes on the following page.

### **Notes About the Detailed Cell Output File**

If a Longley-Rice error occurs and the study was not configured to disregard errors, an error on a “D” record means that there will not be any “U” records following, regardless of whether or not any fields were actually calculated. The cell was counted as interference-free service, or ignored as no service, depending on the study configuration.

Likewise, an error on a “U” record means that there will not be any following “DU” record, since the undesired station was ignored or counted as an interferer, depending on the study configuration.

When evaluating a desired DTS, there will only be one set of values in the “D” record. Those are for the single DTS transmitter providing the strongest field strength in the cell. When evaluating an undesired DTS, the fields after “Source Key” in the “U” line repeat for each transmitter in the DTS that causes interference. Then, the following “DU” line is the result of applying the receive pattern corrections to each field strength and summing the resulting values in power.

The “U” line, thus, looks like this:

```
U, Source Key, Site Number, Field Strength, Bearing, Receive Pattern Adjustment, KWX
  Flag, Site Number, Field Strength, Bearing, Receive Pattern Adjustment, KWX Flag,
  [...] Causes Ix
```

The bearing fields in the “D” and “U” records are bearings from the cell study point back to the station, used to determine receive antenna pattern adjustments.

The D/U ratio value in the “DU” record is based on applying the receive pattern corrections to the undesired signals, and also summing the pattern-adjusted undesired signals from all DTS transmitters.

The DU Ramp Function Adjustment field in a “DU” record is non-zero for co-channel interference to a DTV desired, the required D/U ratio is adjusted by the appropriate amount before comparing to the actual D/U to determine interference.

When a cell has population in multiple countries, the cell is studied at multiple distinct study points, one based on the population from each country. In that case there will be multiple “P” records, one for each country. A portion of the area in such a cell is counted in each country, proportional to that country’s population in the cells versus the total from all countries.

In global grid mode, each [grid] block will contain many [cell] blocks, one for every cell in the grid, which may span the coverage areas of multiple stations. However, even in global mode there may be multiple [grid] blocks within a [scenario] block, because the total area of a large study is automatically partitioned in to sub-grids to manage memory allocation. Typically, studies conducted on computer systems with more physical memory (RAM) will have fewer study grids than systems with less physical memory. Those separate grids may overlap, so it is possible for the same cells to appear in more than one grid, in each case with a different set of desired stations. In other words, a particular [cell] block is not guaranteed to contain all results for that cell; data for the cell may be fragmented in several [grid] blocks.

A line containing [abort] may appear at any point in the data, indicating an error occurred and there is no further data for the scenario; all open data blocks are implicitly closed. When it appears, [abort] does not necessarily indicate the end of the file; another [scenario] block may begin immediately after.

### **Local Grid Mode**

For a study run in local grid mode, the [cell]/[endcell] blocks are replaced by blocks in the following format:

```
[source]
Source Key
P, Lat Index, Lon Index, Country Key for Point, Point Lat, Point Lon, Point Area,
  Point Pop, Clutter
D, Field Strength, Bearing, KWX Flag, Service Flag
U, Source Key, Field Strength, Bearing, Receive Pattern Adjustment, KWX Flag, Causes
  Ix
DU, D/U Ratio, Rule Value for Comparison, D/U Ramp Function Adjustment
[endsource]
```

Each block will have multiple "P" lines, one for each study point considered for one station only. Each "P" line is followed by just one "D" line for that station. "D" lines may be followed by multiple "U" and "DU" lines for all undesired stations checked at that point. Each desired station will have a separate source block. However, there is not a guarantee that "U" records will always follow a "D", nor that a "DU" record will always follow a "U", since Longley-Rice warnings may abort the analysis for that grid cell if TVStudy is set to "Assume Service" or "Assume Interference" when warnings occur and the subsequent records will not be generated.

In local grid mode, each [grid] block encloses just one [source] block, for the desired station that defined the grid. The [scenario] block will therefore typically enclose multiple [grid] blocks, one for each station studied.

A line containing [abort] may appear at any point in the data, indicating an error occurred and there is no further data for the scenario; all open data blocks are implicitly closed. When it appears, [abort] does not necessarily indicate the end of the file; another [scenario] block may begin immediately after.



### **Format of Detail CSV Cell Output File**

Selecting the Detail CSV output option produces three to five csv files depending on the type of analysis performed. None of the files produced contain header rows.

**sources.csv.** This file lists all the sources considered in the analysis and is output for all types of analyses. It lists both desired and undesired sources as well as other pertinent information. This is a comma separated file with 15 fields.

Source Key, Des Flag, Und Flag, Country Key for Station, Service Type, Channel, Service Level, Field Count, Fac ID, Lat Index South Limit, Lon Index East Limit, Lat Index North Limit, Lon Index West Limit, File Number, Call Sign

**D\_CelData.csv.** This file lists, for each grid cell in the study, information about the desired signal and is output for all types of analyses. This file can become very large when more than one source is listed as desired in a study. This is a comma separated file with 10 fields.

Key, Point Lat, Point Lon, Point Area, Point Pop, Clutter, Des Source Key, Des Field strength, Service Flag, KWX Flag

**U\_CelData.csv.** This file lists, for each grid cell in the study and each undesired TV interferer, the desired TV signal strength versus the single undesired TV signal strength as well as the results of the D/U ratio analysis. If the undesired TV stations is a DTS station, then each DTS location is listed on a separate line with the "Site Number" field distinguishing between sites. However, the D/U ratio shown is based on the aggregate field strength of all DTS sites. This file is output for all types of analyses. This is a comma separated file with 19 fields.

Key, Point Lat, Point Lon, Point Area, Point Pop, Undesired Source Key, Site Number, Des Source Key, Des Field strength, Service Flag, Und Field Strength, Receive Pattern Adjustment, Bearing, D/U ratio, D/U Threshold, SNR Factor, Causes Ix, Des Path KWX Flag, Und Path KWX Flag

**U\_eNBCelData.csv.** This file lists, for each grid cell in the study and each undesired wireless station that passes the OET Bulletin No. 74 cull criteria, the desired TV signal strength versus a single wireless station. This file has a separate row for each wireless station in each grid cell within the desired TV station's protected contour. This file is only output when the type of analysis is wireless to TV. This is a comma separated file with 14 fields.

Key, Point Lat, Point Lon, Point Area, Point Pop, Und Source Key, Desired Source Key, Des Field Strength, Service Flag, Und Field Strength, Receive Pattern Adjustment, Bearing, Des path KWX flag, Und path KWX flag

**U\_iRSSCelData.csv.** This file lists for each grid cell in the study the desired TV signal strength versus the root sum square value of all the wireless stations that pass the OET Bulletin No. 74 culling rules. This file is only output when the type of analysis is wireless to TV. This is a comma separated file with 14 columns.

Key, Point Lat, Point Lon, Point Area, Point Pop, Des Source Key, Des Field Strength, Service Flag, Root Sum Square of Wireless, D/U Ratio, D/U Threshold, SNR Factor, Causes Ix, Des Path KWX Flag

## **APPENDIX F**

### **Notes About Opening the Map Output Files**

TVStudy produces four sets of map output files in either ESRI ShapeFile or Google KML format:

**contours** – This file contains the coverage contours projected by TVStudy.

**coverpts** – This file contains the Longley-Rice study points and their result codes.

**points** – This file contains the Longley-Rice study points and their area and population counts.

**sources** – This file contains the locations of all the transmitters studied. For wireless to TV studies, this file contains both the location of the single desired TV transmitter and the location of all the undesired wireless sites and TV stations included in the study.

For those unfamiliar with ESRI Shape Files, all four pieces are required for the files to work properly. Do not delete any of the files.

There are many software applications available for opening and manipulating the ESRI Shape Files that are output by TVStudy. One free piece of software the FCC has used for this task is Quantum GIS, which runs on Windows, Mac, and Linux, and is available at: <http://qgis.org>

To produce useful maps using Quantum GIS, you will need to obtain ShapeFiles separate from those produced by TVStudy, such as files containing political boundary data. A collection of such files can be found here: <http://nationalatlas.gov/atlasftp.html?openChapters=chpbound>

To add output map files to QGIS, you can simply drag the shape file into the “Layers” pane at the left.

The coverpts output file uses the same set of result codes as noted in Appendix B, and you can thus assign a different color to each result code. To get to the properties window, where such assignments can be made, double-click the appropriate shape file in the “Layers” pane at the left. Available for download is a file called TVStudyTemplate.qml, which is a template that works with the ESRI ShapeFile output format to assign the following colors to each class of points:

1 or 11 = Interference-free service	= Green
2 or 12 = Cell contains interference	= Red
3 or 13 = Cell receives no service	= Blue

The sources output map file includes both desired and undesired transmitter locations as well as information on their RCAMSL, HAAT, ERP and antenna orientation. QGIS allows you to specify the symbol color and rotation based on the associated metadata in the sources ESRI Shapefile. Example QGIS templates that work with wireless to TV generated “sources” ShapeFile outputs based on ERP and HAAT are available for download (“WirelessRuleBasedERP.qml” and “WirelessRuleBasedHAAT.qml”)

The map may initially appear distorted. To correct this, locate the “Project Properties” menu option, then check the “Enable ‘on the fly’ CRS transformation” checkbox. Finally, select one of the NAD83 coordinate systems and map projections appropriate to the area under consideration, and the map should redraw in a less distorted manner.

No support for QGIS is provided beyond the simple instructions included in this Appendix.

## **APPENDIX G**

### **Format of the Pair Study Output Files**

***stations.csv*** – This file lists all of the stations in the pair study.

Fac ID, Channel, Des Flag, Und Flag, Service Type, Call Sign, City of License, State of License, Country Key for Station, Status, File Number, Latitude, Longitude

***baseline.csv*** – This file provides the baseline interference and service information.

Fac ID, Channel, Country Key for Point, Noise Lim Area, Noise Lim Pop, Terr Lim Area, Terr Lim Pop, Ix Lim Area, Ix Lim Pop

***replication.csv*** – This file lists replicated parameters for each station on each replicated channel.

Fac ID, Replication Channel, Country Key for Point, Noise Lim Area, Noise Lim Pop, Terr Lim Area, Terr Lim Pop

***points.csv*** – This file provides information on the location of each study point.

Point Key, Lat Index, Lon Index, Country Key of Point, Point Lat, Point Lon, Point Area, Point Pop

***service.csv*** – This file provides information on whether or not there is service at a given point.

Point Key, Fac ID, Channel, Service Flag

***interference.csv*** – This file shows the points with interference along with which paired station causes the interference to that point.

Point Key, Fac ID, Channel, Ix Fac ID, Ix Channel

Please note that all outputs featuring geographic coordinates are in the NAD83 format.

## **APPENDIX H**

### **Format of the Scenario XML Output**

```

<TVSTUDY VERSION="10500">
<SCENARIO NAME="name">
  <DESCRIPTION>
  description text
  </DESCRIPTION>
  <SOURCE (see attributes below)>
    <APAT>
    azimuth,relative field
    .
    .
  </APAT>
  <EPAT>
  depression,relative field
  .
  .
  </EPAT>
  <MPAT>
  azimuth,depression,relative field
  .
  .
  </MPAT>
  </SOURCE>
  .
  .
</SCENARIO>
</TVSTUDY>

```

A SOURCE may contain an APAT providing azimuth pattern data, and either an EPAT (elevation) or MPAT (matrix) providing elevation pattern data. If MPAT data is provided, APAT will also be provided. The MPAT data is normalized so each elevation pattern slice at each azimuth contains a 1.0, and the APAT data provides values at matching azimuths with the relative scaling for each slice.

A DTS operation has the reference facility (bounding contour facility) parameters in the SOURCE attributes; individual DTS transmitters in the operation are provided by DTS\_SOURCE elements within the SOURCE. The attribute SITE\_NUMBER is only used within the DTS\_SOURCE element with SITE\_NUMBER="0" referring to the reference site.

```

<SOURCE>
  <DTS_SOURCE (see attributes below)>
    <APAT>
    </APAT>
    <EPAT>
    </EPAT>
  </DTS_SOURCE>
</SOURCE>

```

When a station record is non-editable in the exporting scenario (meaning it is based directly on a CDBS record), the SOURCE will be just a reference to the CDBS record. In that case it will not enclose any other elements, and will appear as shown below.

```
<SOURCE (attributes)/>
```

If the XML source is a TV station, its attributes can be read directly from an associated CDBS/LMS dataset. In this case, only the DESIRED, UNDESIRED, LOCKED, RECORD\_ID, SERVICE and REPLICATE attributes are required for TVStudy version 2.x XML source files. The SERVICE attribute is not required for XML sources built in earlier versions of TVStudy. The LOCKED flag will always be "true" (the record is non-editable), and the CDBS\_ID attribute provides the CDBS application ID. All data for the record will be loaded directly from CDBS/LMS dataset when the scenario is imported. If the application ID is not found in the importing study's version of CDBS/LMS, the SOURCE entry is ignored (a warning message will be shown during import in that case).

If a record is editable (LOCKED="false"), even when the source for the record is CDBS/LMS, all record data is provided in the export in SOURCE attributes and enclosed elements. In that case it will not be necessary for the application ID to exist in the version of CDBS used by the importing study. The record will be in the imported scenario regardless, however if the application ID does not exist in CDBS of course it will not be possible to revert to the original CDBS record. When exporting a scenario, if it is expected that some CDBS records may not exist in the study where the scenario will be imported, make all of those records editable prior to exporting.

When exporting a Wireless to TV Interference scenario, the wireless frequency and bandwidth are included as parameters in the XML output. These take the following format.

```
<PARAMETER KEY="355">
<VALUE INDEX="0">620</VALUE>
</PARAMETER>
<PARAMETER KEY="356">
<VALUE INDEX="0">5</VALUE>
</PARAMETER>
```

This allows these scenario-specific parameter values to be included with the scenario export file.

## SOURCE Attributes

The following table lists the source attributes and indicates if they are required, optional or not applicable for each type of source.

R = Required

RL = Required only if source is locked

NA = Not applicable (ignored)

RU = Required only if source is unlocked

O = optional

Attribute	Value	TV	DTS	FM	WL	Comment
LOCKED	"true false"	R	NA	R	R	Indicates if the station record is editable, locked records are non-editable. If the source data is to be read directly from CDBS/LMS then the record must be LOCKED="true"
DESIRED	"true false"	R	NA	R	NA	This attribute is only required when the source is part of a scenario element.
UNDESIRED	"true false"	R	NA	R	NA	This attribute is only required when the source is part of a scenario element.
RECORD_ID	"application ID"	RL	NA	RL	NA	In versions of TVStudy prior to 2.0.0, this field is replaced by CDBS_ID. RECORD_ID is appropriate for both CDBS and LMS datasets.
SERVICE	"service code"	R	R	R	R	(e.g. "DT", "WL", "FM")
REPLICATE	"replication channel"	O	NA	NA	NA	Only required when creating a replicated TV station. Can be used with LOCKED="true" or LOCKED="false"
CHANNEL	"channel"	RU	NA	RU	NA	TV or FM channel
ID	"facility id"	RU	NA	RU	NA	CDBS facility ID or equivalent user-entered value for a record that is not based on CDBS
SITE_NUMBER	"dts site numb"	NA	R	NA	NA	Applicable only to the <DTS_SOURCE> element
CELL_SITE_ID	"cell site id"	NA	NA	NA	R	This field plus the SECTOR_ID attribute and is used as the call sign for TVStudy reports.
SECTOR_ID	"sector id"	NA	NA	NA	O	This field is appended to the CELL_SITE_ID attribute with a hyphen separator to form the site call sign used for TVStudy reports.
CLASS	"fm_class"	NA	NA	RU	NA	(e.g. "A", "B1", "C0", etc.)
COUNTRY	"country code"	RU	NA	RU	R	Station country: "US", "CA", or "MX"

Attribute	Value	TV	DTS	FM	WL	Comment
DRT	"true false"	O	NA	NA	NA	If false or missing TVStudy assumes that the station is not a digital replacement translator
LATITUDE	"latitude"	RU	R	RU	R	Can be decimal degrees with positive for Northern hemisphere or DMS_H. For wireless sites, use NAD83 while for TV or FM stations use NAD27.
LONGITUDE	"longitude"	RU	R	RU	R	Can be decimal degrees with positive for Western hemisphere or DMS_H. For wireless sites, use NAD83 while for TV or FM stations use NAD27
CALL_SIGN	"call"	RU	NA	RU	NA	
CITY	"city"	RU	NA	RU	O	
STATE	"state"	RU	NA	RU	O	
ZONE	"zone"	O	NA	NA	NA	TV Zone: "1", "2", or "3".
STATUS	"status"	O	NA	O	NA	Record status: "APP", "CP", "CP MOD", "LIC", "GRANT", or "STA"
FILE_NUMBER	"file_number"	O	NA	O	NA	
IBOC	"true false"	NA	NA	O	NA	Only needed if IBOC employed, if missing assumed to be false
IBOC_ERP	"iboc_erp"	NA	NA	O	NA	In kW; if missing assumed to be -20 dBc
OFFSET	"offset"	O	NA	NA	NA	Offset code: "Z", "+", or "-". In the case of no offset, the attribute does not appear.
MASK	"mask type"	O	NA	NA	NA	Emission mask code: "S", "T", or "F"; Appears only if mask setting is relevant to the record service (usually low-power television and similar records)
HAMSL	"hamsl"	RU	R	RU	R	Antenna height in meters above mean sea level. Entering -999 will cause this value to be calculated if a value is given for HAAT
HAAT	"haat"	RU	R	RU	R	Antenna height above average terrain. Entering a value of -999 will cause this value to be calculated if a value is given for HAMSL
ERP	"erp"	RU	R	RU	R	Peak horizontal effective radiated power, kW
HAS_APAT	"true false"	O	O	O	O	If false or missing, then any APAT data included in XML record will be ignored.
USE_GENERIC	"true false"	O	O	O	O	If false or missing, then generic elevation pattern will not be applied when elevation pattern is missing



Attribute	Value	TV	DTS	FM	WL	Comment
ANTENNA_ID	"x"	0	0	0	0	Reference integer to antenna pattern. This field is for informational purposes only. Imported XML stations must include the antenna pattern data in the XML file or use omni-directional by default.
APAT_NAME	"name"	0	0	0	0	
APAT_ORIENT	"azimuth"	0	0	0	0	Degrees true north. If missing then azimuth orientation is set to 0
HAS_EPAT	"true false"	0	0	0	0	If false or missing, then any EPAT data included in XML record will be ignored
EPAT_NAME	"name"	0	0	0	0	
EPAT_ETILT	"tilt"	0	0	0	0	Elevation pattern electrical tilt, degrees of depression.
EPAT_MTILT	"tilt"	0	0	0	0	Elevation pattern mechanical tilt, degrees of depression
EPAT_ORIENT	"azimuth"	0	0	0	0	Orientation of mechanical tilt, degrees true north
HAS_MPAT	"true false"	0	0	0	NA	If false or missing, then any MPAT data included in an XML record will be ignored
MPAT_NAME	"name"	0	0	0	NA	Identifying name of the matrix elevation pattern.

## **APPENDIX I**

### **Examples of Valid Input for “Add SQL”**

#### ***CDBS and LMS***

The following table contains several common examples of Additional SQL, which may be used in searches for stations. It is by no means exhaustive, but should cover some of the most common use cases for CDBS datasets.

Choose a state	facility.comm_state = 'VA'
Choose multiple states	facility.comm_state IN('VA','DC','MD')
Choose a city of license	facility.comm_state = 'VA' AND facility.comm_city = 'Roanoke'
Choose a channel	tv_eng_data.station_channel = 51
Choose a range of channels	tv_eng_data.station_channel >= 14 AND tv_eng_data.station_channel <= 20
Choose only Zone I	tv_eng_data.fac_zone = 1

Here is the same table for LMS datasets.

Choose a state	application_facility.afac_community_state_code = 'VA'
Choose multiple states	application_facility.afac_community_state_code IN('VA','DC','MD')
Choose a city of license	application_facility.afac_community_state_code = 'VA' AND application_facility.afac_community_city = 'Roanoke'
Choose a channel	app_antenna_frequency.aafq_channel = 51
Choose a range of channels	app_antenna_frequency.aafq_channel >= 14 AND app_antenna_frequency.aafq_channel <= 20
Choose only Zone I	application_facility.afac_facility_zone_code = 1

Any of these statements can be linked together in both CDBS and LMS datasets using the AND operator, the OR operator, and parentheses. Please consult a SQL guide for further details.

For a full list of fields in CDBS, please see the following web page:

<http://www.fcc.gov/ftp/Bureaus/MB/Databases/cdb/ readme.html>

For a full list of fields in LMS, please see the following PDF:

<https://enterpriseefiling.fcc.gov/dataentry/api/download/lmschema>

**Wireless**

Wireless datasets are stored within TVStudy within a table named "base\_station". The following fields are available for SQL searches from the "base\_station" table:

cell_key	integer
cell_site_id	varchar(255)
sector_id	varchar(255)
cell_lat	float
cell_lon	float
rc_amsl	float
haat	float
erp	float
az_ant_id	integer
orientation	float
el_ant_id	integer
e_tilt	float
m_tilt	float
m_tilt_orientation	float
reference_number	char(22)
city	char(20)
state	char(2)
country	char(2)

The following are some examples of SQL statements that can be used to find wireless base stations within a wireless dataset:

Choose by cell site ID	base_station.cell_site_id LIKE "PEA103%"
Choose by sector orientation	base_station.orientation >= 0 AND base_station.orientation <= 45
Choose by city	base_station.city = "Front Royal"

**User Records**

User records are stored within TVStudy within a table named "user\_record". The following fields are available for SQL searches from the user\_record table.

user_record_id	integer
record_type	integer
xml_data	text
facility_id	integer
service_key	integer
call_sign	char(12)
status	char(6)
channel	integer
city	char(20)
state	char(2)
country	char(2)
file_number	char(22)
comment	text

Please note that the technical parameters for the record are contained within the xml\_data field.